Power Engineering

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Whatever you want in a mechanical drive turbine...

HERE IT IS!

Looking for low maintenance?

AIRWALL LABYRINTH SEALS WITH NO RUBBING CONTACT protect bearings against dust, fly ash, etc. —

CENTERLINE SUPPORT assures constant alignment at all times, irrespective of possible expansion due to temperature changes —

PACKING GLANDS REMOVABLE without raising upper half of turbine casing —

SHAFT IS SPRAY COATED WITH STAINLESS STEEL under the packing gland, eliminating special maintenance after shutdown —

TURBINE BUCKETS AND SHROUD OF STAINLESS STEEL for maximum life and sustained efficiency —

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CONSTANT SPEED GOVERNOR READILY ADJUSTED for permanent speed change —

BUILT-IN STEAM STRAINER of heavy stainless steel

and

STANDARDIZED PARTS that fit all YR Turbines, greatly reducing parts inventory.

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EIGHT DIFFERENT STANDARDIZED TURBINE TYPES — Five frame sizes — Capacities to 2000 hp. — Speeds, 800-7000 rpm. — Back pressures to 250 psig.

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3. Air-operated remote control —
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5. Variable speed oil relay type —
6. Built-in constant or differential pressure pump type —

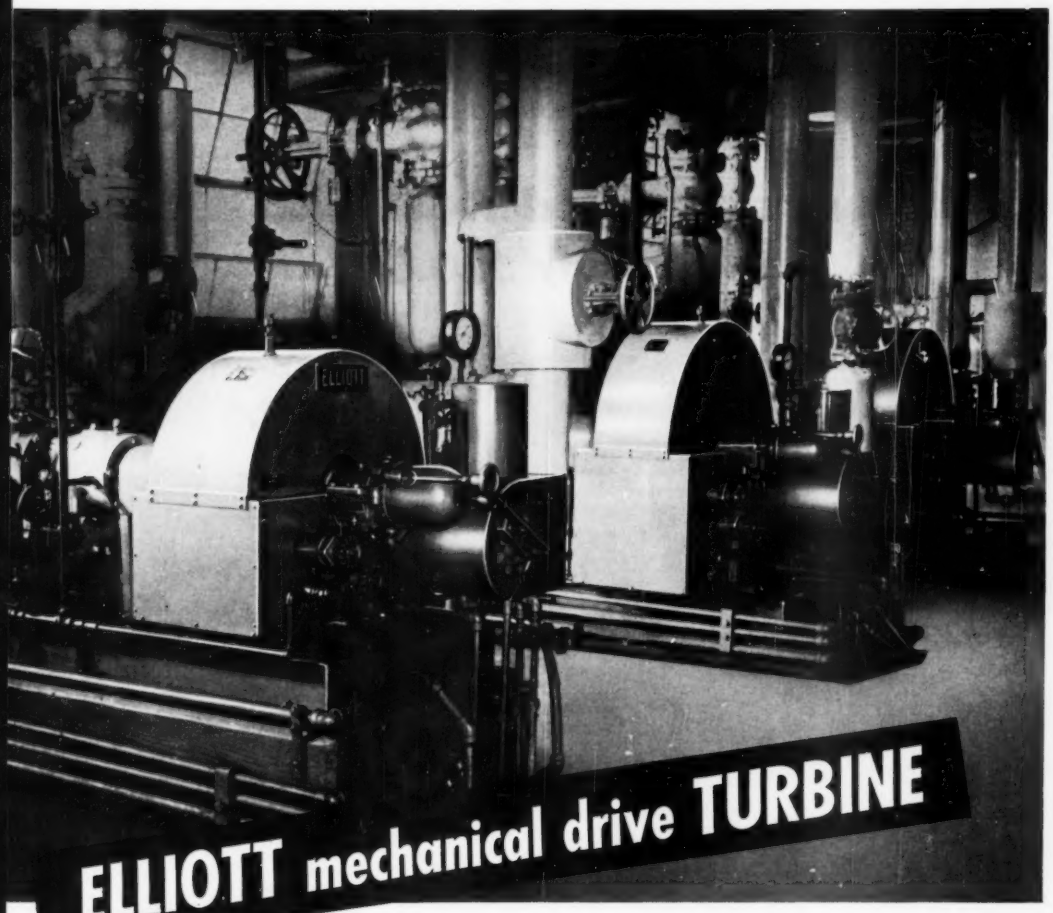
PERMISSIBLE MODIFICATIONS IN CONTROLS—

1. Two hand valves — controlling excess nozzling —
2. Hand-operated speed-changer, adjusting speeds while operating —
3. Remote control speed changer, air or electrically operated, adjusting speeds while operating —
4. High exhaust pressure trip actuating emergency trip valve —
5. Remote control electrical trip actuating emergency trip valve —
6. Throttling type emergency trip valve for hand throttling.

GLAND SEAL PIPING for condensing operation — or for operation with gas.

EXHAUST CONNECTION LOCATION optional — either right or left side.

H-736



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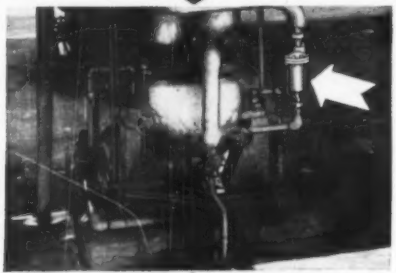
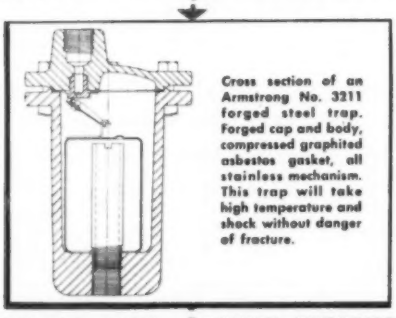


SAFETY . . . DEPENDABILITY



Cross section of an Armstrong No. 3211 forged steel trap. Forged cap and body, compressed graphited asbestos gasket, all stainless mechanism. This trap will take high temperature and shock without danger of fracture.

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NOW, for many applications, power plants, refineries, chemical processing and other industrial plants can have the advantages of a forged steel steam trap for only a few dollars more than a cast iron trap of comparable size. The Armstrong No. 3211 trap illustrated will withstand fire or explosion without danger of fracture, is ideal where all steel installations are desired. It is the baby of the Armstrong forged steel line, a low priced trap for working pressures up to 250 psig; design pressure, 450 psig. Capacity range 750 to 1000 lbs/hr continuous. $\frac{1}{2}$" or $\frac{3}{4}$" pipe connections. Diameter $4\frac{1}{4}$"; height 7"; weight 8 lbs.

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Power Engineering

Combining POWER PLANT ENGINEERING and POWER GENERATION

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January, 1952

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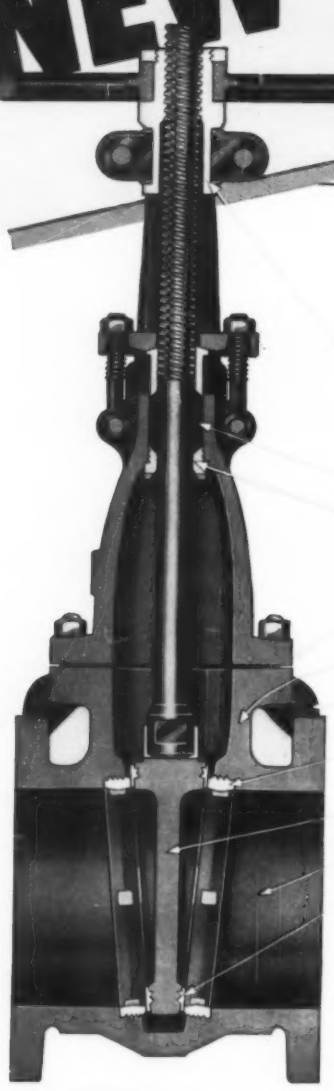
The only magazine devoted exclusively to the engineering interests and practical problems of power engineers

NEW . . . a completely redesigned line of IRON VALVES by OIC



NOW the workhorse of the family—OIC's iron valve—offers you features formerly found only in steel valves. It's a brand new valve built around more than a third of a century's experience in making iron valves. We kept only the old handwheel.

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VALVES

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ENGINEERS' PREVIEW

ENGINEERING CONSTRUCTION in the Arctic is becoming more important every day. Permanently frozen surface materials of the earth, such as muck, sand, gravel and ice complicate design and construction of dams, buildings, roads, landing strips and other structures. Permafrost exists over all of northern Alaska, lying in continuous strata or in sheets, and lenses separated by permanently thawed material.

The ASCE annual meeting heard about it from G. W. Rathjens, consulting engineer of Berkeley, California, who has had a decade of experience with engineering structures in Alaska. In the solution of any design or construction problem in a permafrost area, he said, "one of the first decisions which the engineer must make is whether to disturb the permafrost or to arrange construction so that it will not be disturbed."

In construction of a 6500-kva steam power plant near Fairbanks in 1926, the site selected appeared, after exploratory drilling, to be thawed gravels. As excavation progressed, it developed that only a portion of the gravels were thawed and that the site was over a very large kidney of dry permafrost. Water was moving in the gravels past the kidney but the closely packed material in the kidney itself was dry.

While original plans called for a foundation of piles to be driven into the thawed gravels above the kidney and into the frozen sands and gravels of the kidney itself, a careful investigation convinced the engineers that the foundation should be redesigned to eliminate the piling and to support the structure on thawed sand and gravel which would distribute the load to the kidney itself.

Heat to thaw a portion of the dry permafrost was supplied from two locomotives to pipes covering the extent and depth of the area — 100 ft greater in each horizontal direction than the size of the proposed structure and to a depth 30 ft below the footings of the proposed structure. In this manner the thawed sands and gravels were confined by permanently frozen materials.

For over 20 years the power plant has been in satisfactory operation with no indication of foundation trouble. "Had piling been driven or explosives used in this excavation as they are ordinarily used in the temperate zone," Mr. Rathjens concluded, "the permafrost kidney might have been so disturbed that live ground water would have moved into and through the fractured zones and caused unwelcome thawing accompanied by continuous serious settlement."

★ ★ ★

PICTURES of greater sharpness to the eye will ultimately come from new photographic materials as a result of a highly technical photographic investigation reported by Dr. George C. Higgins and Dr. Loyd A. Jones of Kodak Research Laboratories. The report changes the generally accepted belief in photographic circles that resolving power can be used to rank photo materials in the same order of sharpness as visual judgment of pictures. Their research on the way the human eye sees a picture, plus study of the physical structure of the photographic image, led them to their new method. Essentially, it is a method of making objective measurements that correlate with picture sharpness as the eye sees it.

WE'LL PUMP WATER DOWNHILL, says San Diego, Calif. Faced with mushrooming Navy facilities, expanding industry and just plain more people, San Diego plans to increase its water supply 20 per cent by pumping water downhill. Seems the city's water comes from the San Vincente Reservoir by gravity flow. To force more water down the system, the city fathers decided to install three centifugal pumps, powered by 200-hp motors, to boost the flow from 45,000,000 to 55,000,000 gallons every day. A $100,000 new plant will house the project to supply water for the second largest Navy base in the country.

★ ★ ★

BEFORE the 1951 Photographic Society of America convention in Detroit, to demonstrate the speed of "hot photography," Eastman Kodak technicians turned movie cameras on members of the audience. The 16-mm film was processed with heated photo solutions and immediately projected — all in less than 10 min. Polaroid Corp scientists used special Land film-and-chemical sandwiches to show speedy, new x-ray processing, delivering pictures quickly enough to make them immediately useful during a surgical operation.

First public showing of a Xerography process that permits positive reproductions from either negative or positive microfilm originals included on-the-spot making of multilith plates. Photography joined with music to cap the program when a Detroit organist played selections on a Baldwin Photoelectric Organ.

★ ★ ★

WHENEVER we see an especially good technical catalog in the power field, we like to award it our honorary carnation (more rugged and masculine — more fitting to the power industry, we think — than the traditional orchid).

This time our carnation goes to a splendid catalog on adjustable pipe hangers, vibration eliminators and supports — Catalog No. 51 of the Power Piping Division of Blaw-Knox Construction Co. Here is the thing that wins the carnation, as always: A catalog crammed with technical data of the most practical usable kind, yet at the same time extremely attractive to look at, simple and clear and with all the data tabulated and arranged so the pipe designer and layout man can find them quick. And of all things, prices! — almost unheard of today.

Dimension drawings and tables show all the company's functional hangers (unlimited headroom, restricted headroom, larger vertical movement, etc.) There are similar data for rolling assemblies, vibration eliminators and all sorts of hangers and parts. A Technical Section gives specs for hangers and supports, typical hanger problems and — note well — tables of weights of piping materials. There is a chart showing expansion of pipe for all pressures and temperatures and the book closes with an outline of the Flex-Anal charts for the experienced designer. Color is used simply and effectively in this catalog.

There are so many good technical catalogs today that a new one has to be outstanding to win our carnation. This one is! We wrote new bulletin notes for years on POWER PLANT ENGINEERING in the days when most catalogs contained no information whatever. That's how we know!

POTENTIAL large-scale demand for fission products exists in industry, but many technical and economic problems must be solved before promising new uses for these by-products of the atomic energy program can develop. This was the broad finding and conclusion of Stanford Research Institute from a recent techno-economic survey of industrial uses of radioactive fission products conducted for the United States Atomic Energy Commission and announced in a recent report.

Millions of curies of radioactivity are contained in the process wastes left over from the production of plutonium in the AEC's nuclear reactors. Of no use for industrial or explosive power or as a heat source, these fission products are known to be a potential source of large quantities of low-cost radiation. Refinement and concentration of the gross fission products, now stored at AEC installations, will undoubtedly be necessary to make them suitable for industrial purposes, the SRI study indicates.

Present commercially feasible industrial uses include the activation of phosphors for self-luminescent signs and markers, static eliminators for a variety of industrial processes, reduction of starting voltage requirements in fluorescent light tubes and in process control instruments which incorporate a source of radiation.

Possible future uses for fission products, where the technology and desirability of use will require at least two to five years for development, include industrial radiography, cold sterilization of drugs and foods and portable low-level power sources. In the highly speculative area where basic technical knowledge is lacking, possibilities exist for uses in radiation chemistry and flame propagation.

★ ★ ★

USERS of basic aluminum pig and ingot are now assured of a plentiful supply of the light metal for years to come, under terms of precedent-setting contracts between Aluminum Co. of America and the General Services Administration of the U. S. Government.

A contract signed today provides that the Government will have first call for five years on the aluminum output of the new smelting plant being built by Alcoa at Rockdale, Texas. When month-to-month Government requirements take less than two-thirds of the metal produced there, however, the remaining aluminum up to the two-thirds total will be made available to other users of aluminum in the form of pig or ingot during the five year period.

At the conclusion of the five year term, such pig and ingot customers will continue to have first call on 25 per cent of Alcoa's Rockdale production for an additional fifteen years. The remaining aluminum produced by the new expanded facilities will be made available to the market in the form of semi-fabricated and fabricated products.

Similar agreements were recently reached by Alcoa and GSA concerning the aluminum output of the company's new smelting facilities now being built at Wenatchee, Washington, and of two additional smelting lines currently being built to augment Alcoa's existing works at Point Comfort, Texas.

★ ★ ★

BLOOD PLASMA, for the treatment of military casualties as well as civilians, might be sterilized with high-energy electron rays more efficiently than with methods now employed, according to a GE scientist. He said that ultra-violet rays are now employed for sterilization. While these rays do not heat the plasma, they do not penetrate into it as deeply as would the high-voltage cathode rays. Thus sterilization with electrons might be more efficient.

ITALY, having only its northern mountainous provinces available for the production of electricity by water power, has now closed the contract for a project which will be one of Europe's largest electrical production centers, said to be able to turn out 1,500,000,000 kwh annually.

Located in the Alps near Venzone, in the Tagliamento Valley, a one-mile-long dam, 200 ft high, containing 17,000,000 cu m of earth, will store 700,000,000 cu m of water in the Carnia Lake, while a second dam, 700 ft long and 90 ft high (containing 300,000 cu m of earth as dam-building material) will store another 100,000,000 cu m of water.

Ten electric plants are to be erected, following the example of the Tennessee Valley plan. These plants will be located partly underground. In fact, the two largest plants, the first ones in the row after the dams, will be completely inside the granite mountain structure. The other smaller plants will be of conventional type, but will be for all-year-round use, while the first two mentioned will only be put into operation in times of increased need of electricity.

One of the problems arising from the construction of the system of dams and power plants is the re-routing of roads and railroads. Of importance also is the fact that new agricultural land will possibly be won after the regulation of the Tagliamento River, whose bed now covers a large area, while the amount of water flowing in the bed is too small to insure a normal supply of water to the consumers along the river. Erection of the dams would not only produce electricity, but would also insure a steady flow of water in the new, more confined channel.

★ ★ ★

ONE PROMINENT trend which has continued during the period covered by the latest report of the ASCE's committee on Water Supply Engineering is the increase in cost of water works operation, maintenance and construction. An indication of the extent of this trend is the 72 per cent increase reported by *Engineering-News-Record* since January 1, 1945 and about 15 percent since January 1, 1949.

The committee went on to report at the Annual Convention of the Society that many water works systems have found it necessary to increase rates to meet these higher costs and in some instances, dissipation of reserves and curtailment of needed improvements have resulted from the decrease in net income.

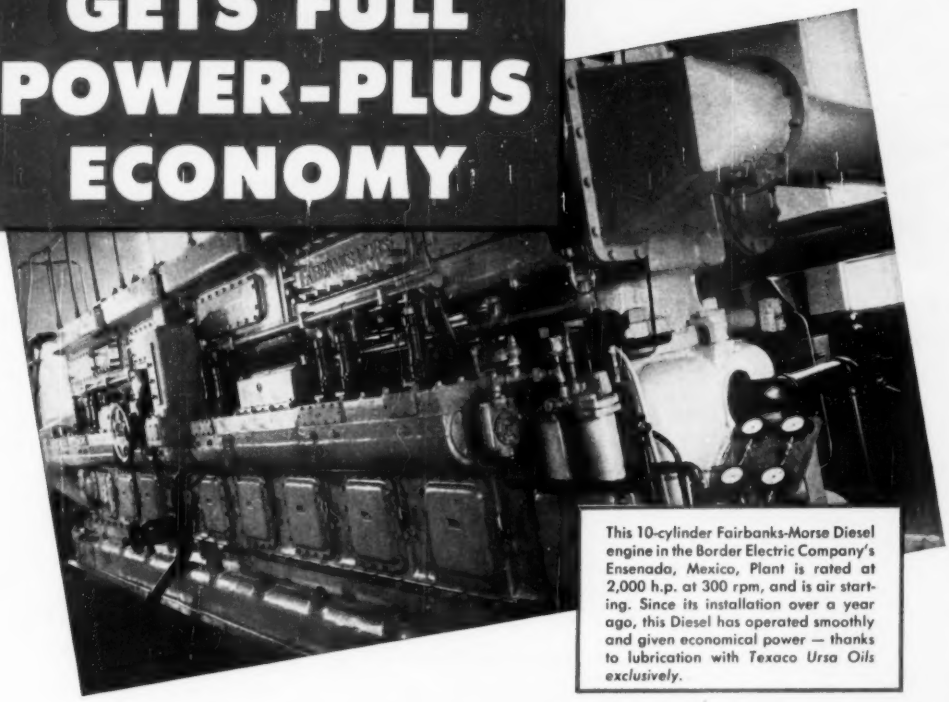
Another trend disclosed by the committees' report was the increase in per capita consumption of water particularly in urban areas.

The report also includes studies of the use of flouride to reduce dental caries in children, the seeding of clouds to produce precipitation and investigations of the reclamation of sea water. The report has also concerned itself with treatment of water to correct the effect of industrial and radio-active wastes.

★ ★ ★

NEW COAL-MINING-AUGER machine by a West Virginia coal company has just made big news. This remarkable tool is, in effect, a giant machine drill over 4 ft in diameter and over 200 ft long. Turned by a high-powered engine, it bores a horizontal hole along the flat-lying coal seams and drills coal out of the earth in a fast, continuous flow. The coal company operates six of these mammoth augers in parallel. And as the coal comes out, automatic conveyors load it into trucks. This efficient operation, handled by a four-man crew, can turn out as much as 700 tons of coal per hour.

GETS FULL POWER-PLUS ECONOMY



This 10-cylinder Fairbanks-Morse Diesel engine in the Border Electric Company's Ensenada, Mexico, Plant is rated at 2,000 h.p. at 300 rpm, and is air starting. Since its installation over a year ago, this Diesel has operated smoothly and given economical power — thanks to lubrication with *Texaco Ursa Oils exclusively.*

...with the help of TEXACO URSA OILS

As in the plant illustrated, operators of Diesel, gas, and dual-fuel engines everywhere are getting full power and low maintenance costs with the help of *Texaco Ursa Oils.* These oils reduce fuel consumption because they keep rings free, ports open, and valves functioning properly — assuring better compression and combustion.

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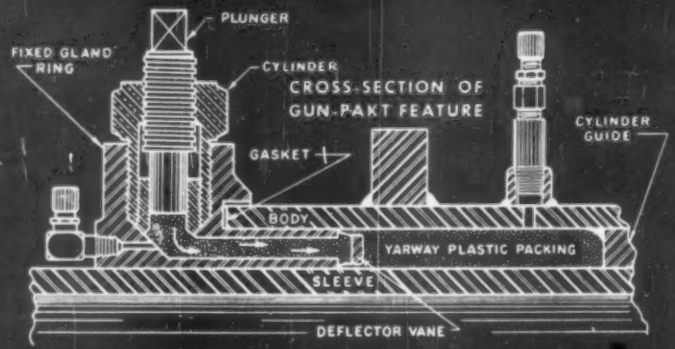
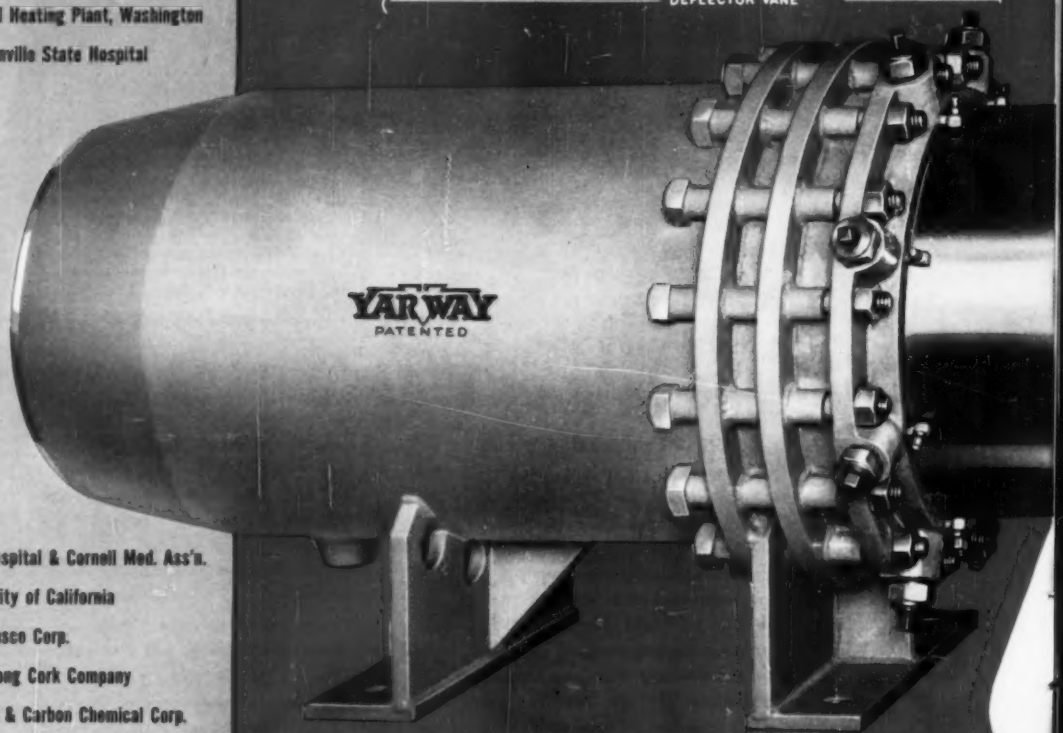
this expansion joint





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offers...

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Yarway Single-end Gun-Pakt Expansion Joint, welding type. Double-end and flanged types also available.

What feature do you want most in an expansion joint . . . sure movement, simplified installation, ease of servicing, low cost, low upkeep?

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Gun-Pakt Joints are *rugged* joints, strong and dependable. They are *serviced under full steam pressure.* Packing is added simply by inserting a plug of Yarway plastic packing and turning a wrench . . . the joint's tight, the job done.

FEWER JOINTS NEEDED

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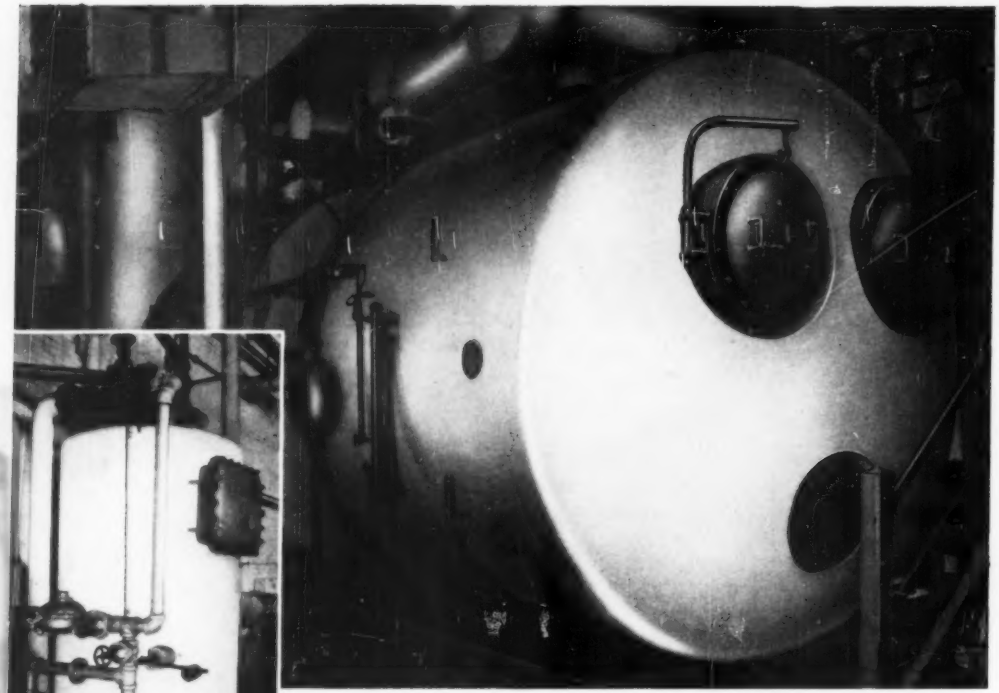


A Big Help

on small—as well as big—deaeration jobs

Small deaerators are big business at Worthington! That's why the plant with small-capacity requirements will benefit by getting acquainted with the complete range of Worthington deaerating equipment.

Worthington Gives You All Types, All Sizes

Worthington deaerating heaters and deaerators are built in sizes to handle from a few thousand pounds an hour to over a million. They are tailor-made to fit the particular requirements of each job. Special designs are available for operation with scale-forming water.

Both tray and steam-jet types are made—with external surface-type vent condensers or internal direct-contact vent condensing. They can be furnished for any practical operating pressure—constant or variable—or for vacuum operation.

With a complete range of sizes and types at their fingertips, Worthington engineers can competently recommend the design best suited to *your* requirements.

Remember, too, Worthington designs are backed by over 50 years experience in the design and manufacture of direct contact feedwater heaters and over 100 years experience in hydraulic machinery.

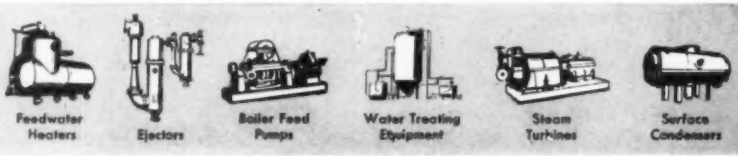
Send your water treating problem to Worthington Pump and Machinery Corporation, Steam Power Division, Harrison, N. J.

WORTHINGTON

DEAERATORS

S.1.5

A GREAT TEAM IN STEAM



Burn REFUSE or COAL

With DETROIT STOKERS

Successful Installations Burn

Hogged Wet or Dry Bark
Hogged Wood
Wood Shavings and Sawdust
Wood Sander Dust
Spent Tan Bark
Corn Cobs
Coffee Refuse
Oat Hulls
Coconut Shells
Tobacco Stems
Leather Scraps
Peanut Shell Refuse

—Either separately or in combination with coal, oil or gas

The use of the Detroit RotoStoker and RotoGrate Stoker for various kinds of waste materials, followed quite naturally its established use for burning an extremely wide range of Coals, as well as high moisture Lignite.

Through the years, installations with steam boilers of a wide range of types and sizes have been made for burning waste materials.

If you have combustible refuse, the best disposal method is *burning it* which will avoid nuisance or pollution and at the same time will salvage the fuel value.

Detroit RotoStokers and Detroit RotoGrate Stokers are readily adapted and highly successful for refuse burning.

Write for this 24 page Booklet 505 which gives Engineering data on our refuse burning installations.

DETROIT SINCE 1898 STOKERS

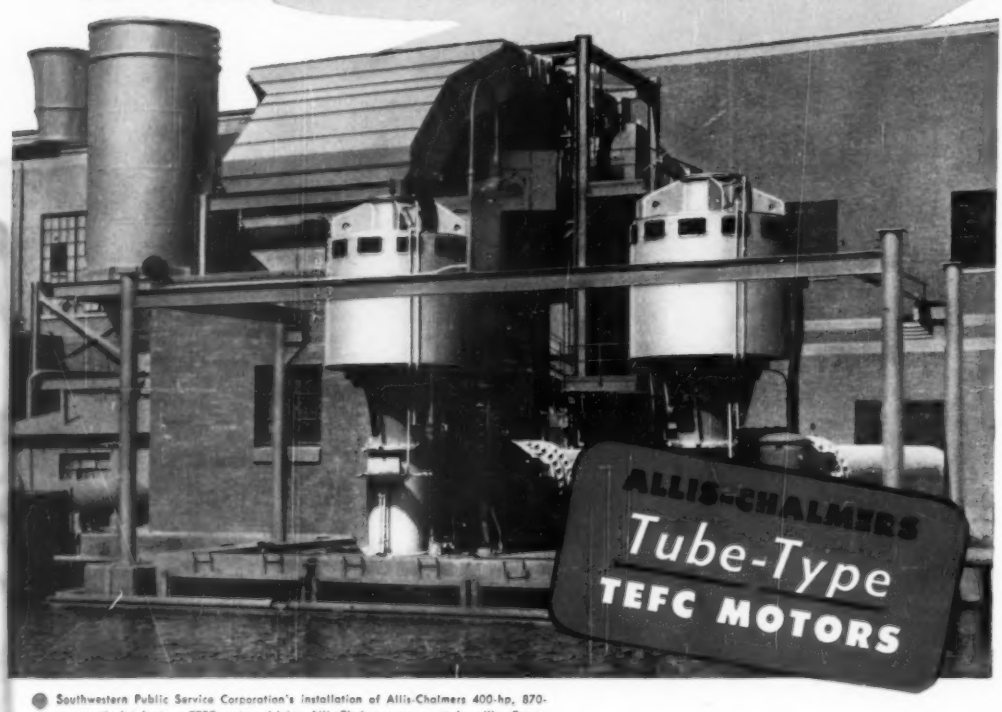
DETROIT STOKER COMPANY

General Motors Building • Detroit 2, Michigan

District Offices in Principal Cities • Works at Monroe, Mich.

Open Sky

IS ALL THE ROOF THEY NEED



Southwestern Public Service Corporation's installation of Allis-Chalmers 400-hp, 870-rpm vertical *tube-type* TEFC motors driving Allis-Chalmers pumps at Amarillo, Texas.

What does it cost to house a motor? Nothing — if it's an Allis-Chalmers *tube-type* totally-enclosed fan-cooled motor. Then the sky is roof enough. And it need not be blue sky either.

These motors aren't afraid of fog, rain, snow, salt, coal dust, soot, alkalies, or mild acids in the air. They're built to take care of themselves . . . and to save you money. The opportunity for low installation cost is only the beginning. Peak reliability and low maintenance pay worth-while dividends throughout the long life of the motors.

Why? Because their *tube-type* air-to-air heat exchanger design offers you these advantages:

1. *Self-cleaning action* . . . result of generous flow of outside air through smooth, straight cooling tubes.
2. *Complete enclosure* . . . protects stator core and other electrical parts from dirt and corrosion.
3. *Full internal air circulation* . . . provides efficient, even cooling—makes large sizes practical.

These are proved advantages, for purchases have exceeded 170,000 hp in sizes from 250 to 2500 hp. Introduced in 1946, *tube-type* motors are now available down to 40 hp at 600 rpm.

Bulletin 05B7150 describes these motors that are equally at home indoors or out. Call your A-C representative, or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3534

Also available in horizontal designs.

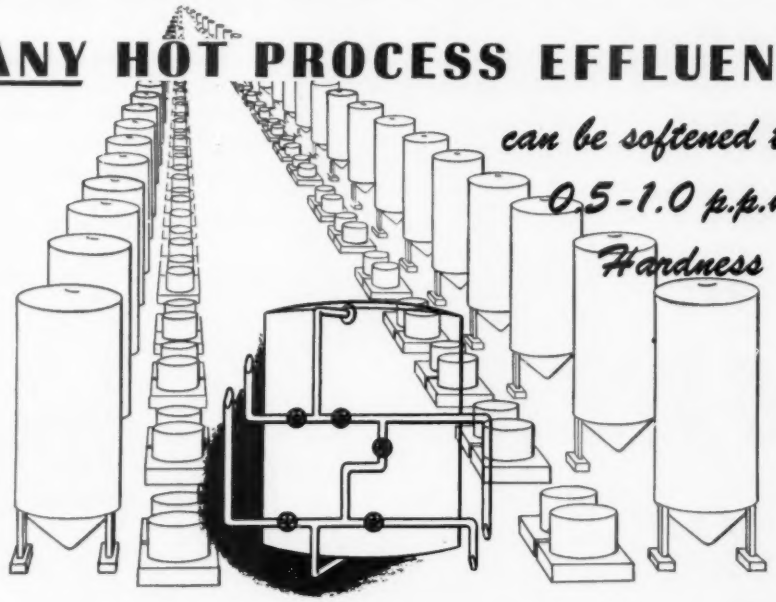
ALLIS-CHALMERS

ANY HOT PROCESS EFFLUENT

can be softened to

0.5-1.0 p.p.m.

Hardness



THESE WIDELY VARYING WATERS CAN ALL BE TREATED BY HOT LIME-ZEOLITE PROCESS*

(Using Nalcite HCR)

	A	B	C	D	E	F	G
Hardness as $CaCO_3$ (p.p.m.)	128	27	247	163	200	167	405
Ca as $CaCO_3$ (p.p.m.)	87	18	152	139	100	110	258
Mg as $CaCO_3$ (p.p.m.)	41	9	95	24	100	57	147
"P" as $CaCO_3$ (p.p.m.)	0	0	0	0	0	0	0
"M" as $CaCO_3$ (p.p.m.)	1	12	157	154	121	139	296
Cl and SO_4 as $CaCO_3$ (p.p.m.)	171	25	81	27	104	41	132
Fe as Fe (p.p.m.)	12			3	5		
SiO_2 as SiO_2 (p.p.m.)	5	10	26	22	58	3	15
pH	4.4				7.5	8.3	

* All these waters can be softened to less than 1.0 p.p.m. hardness.

Technical Data on Nalcite HCR

Nalcite HCR is a high-capacity styrene type cation exchange resin, with full exchange capacity at temperatures up to 250°F. This new technical bulletin, No. 58, gives you complete information on all advantages of Nalcite HCR. Write for your copy... free upon request.

with

Nalcite HCR

(HOT LIME-ZEOLITE PROCESS)

WATER softening with hot lime-zeolite (using Nalcite HCR) comes close to the ideal of plant operators in need of "zero" hardness water in large quantities . . . either for boiler feedwater make-up, or process use.

The ion exchange softener, employing Nalcite HCR, installed following any hot lime primary unit makes for simplicity of the entire process design and operation. No complex control procedures are required, thus making the process inherently trouble-free.

Where "difficult" raw waters have made other softening methods impractical, a check on the table at left will show that virtually any raw water can be—and is being—treated successfully and economically with this process.

For full details on Nalcite HCR write Nalco or contact your Nalco Representative today.

NATIONAL ALUMINATE CORPORATION

6224 West 66th Place • Chicago 38, Illinois

In Canada: Alchem Limited, Burlington, Ontario

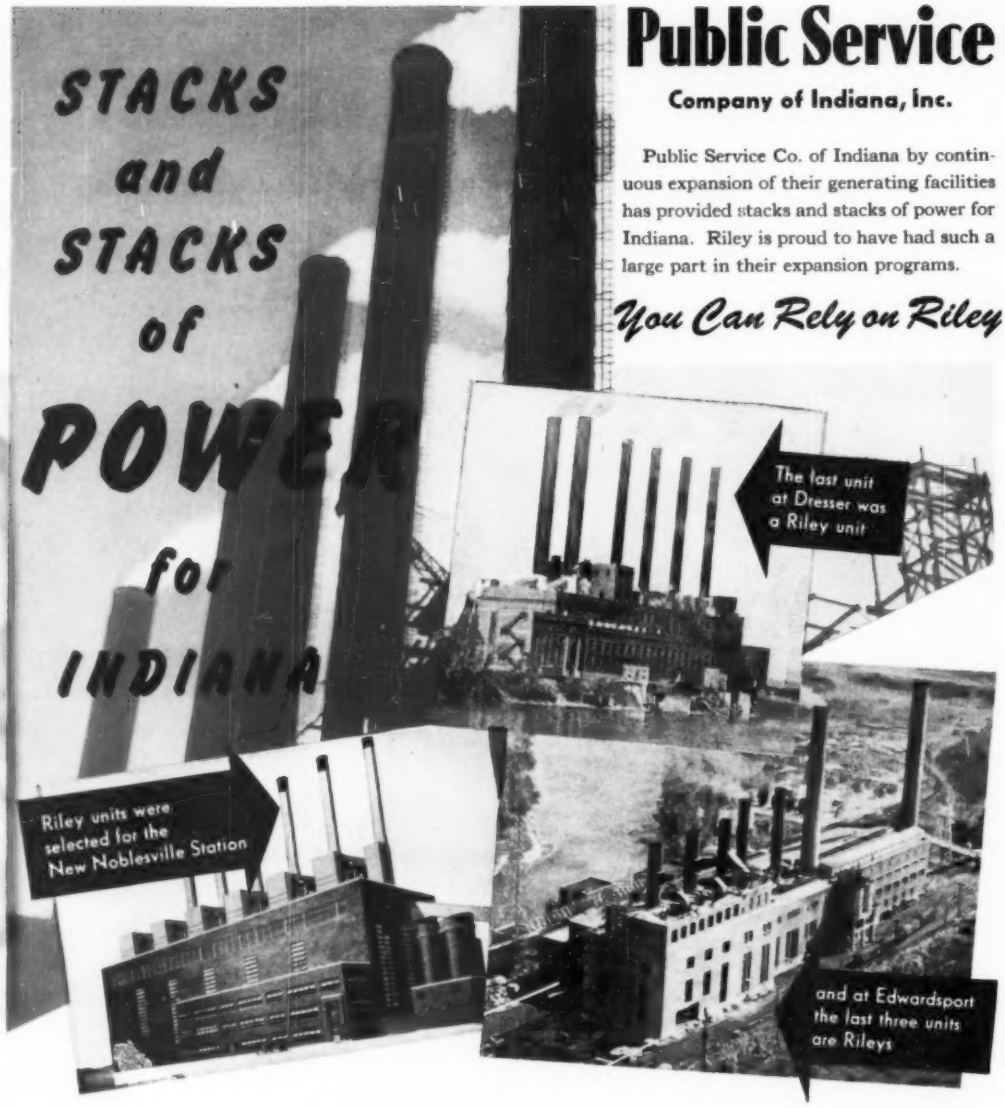
A *Nalco*® **PRODUCT** . . . *When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.*

Public Service

Company of Indiana, Inc.

Public Service Co. of Indiana by continuous expansion of their generating facilities has provided stacks and stacks of power for Indiana. Riley is proud to have had such a large part in their expansion programs.

You Can Rely on Riley



TRADE MARK REGISTERED

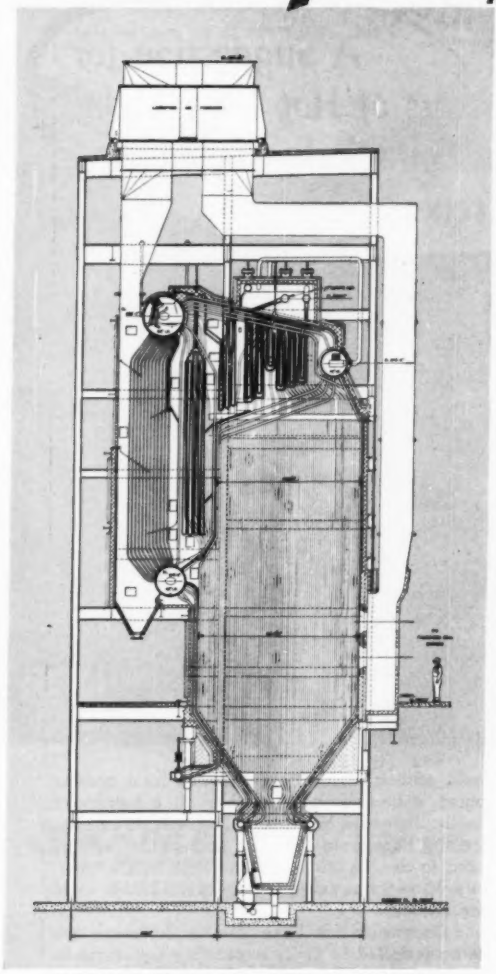
RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Washington Buffalo Pittsburgh Cleveland Detroit Chicago
Cincinnati Atlanta New Orleans St. Louis Kansas City St. Paul Tulsa Houston Denver
Salt Lake City Los Angeles Portland Seattle

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • FLUE GAS SCRUBBERS

Installed 7 Riley Units Since 1947



PUBLIC SERVICE COMPANY OF INDIANA
NOBLESVILLE STATION
3—300,000 lbs. /hr. Riley Units
1025 psig—950°F. Temperature

Public Service Company of Indiana Selected Riley Steam Generating Units for their latest additions to Dresser and Edwardsport Stations and also for their new Noblesville Station. Sargent and Lundy were Consulting Engineers.

Riley History of Public Service Co. of Indiana

First Order—July-1946
1—300,000 lbs. /hr. Riley Unit for Dresser Station

Second Order—Sept.-1946
2—400,000 lbs. /hr. Riley Units for Edwardsport Station

Third Order—July-1947
3—300,000 lbs. /hr. Riley Units for Noblesville Station

Fourth Order—March-1949
Another 400,000 lbs. /hr. Riley Unit for Edwardsport Station

Total 4 orders—7 Units—Total Capacity 2,400,000 lbs. /hr.

All of these Public Utilities have Purchased Riley Steam Generating Units.

Monongahela Power Co.
Houston Lighting & Power Co.
Iowa Electric Light & Power Co.
Utah Power & Light Co.
S. Carolina Elec. & Gas Co.
Union Electric Co. of Illinois
Southwestern Public Service Co.
New Orleans Public Service Co.
Gulf Power Co.
Florida Power & Light Co.
Ohio Edison Co.
Southern Ind. Gas & Elec. Co.
Interstate Power Co.
Upper Michigan Power & Light Co.
Central Ohio Light & Power Co.
Natrona Power & Light Co.
Cambridge Electric Light Co.
West. Colorado Power Co.
Newport Electric Co.
Northwestern Public Service Co.
S. Carolina Public Service Authority
The Potomac Edison Co.
Northern States Power Co.
Arkansas Power & Light Co.
Central Illinois Light Co.
Public Service of Indiana
Northern Virginia Power Co.
Carolina Power & Light Co.
Worcester County Electric Co.
Penn. Electric Co.
Iowa-Illinois Gas & Electric Co.
Mississippi Power Co.
Lynn Gas & Electric Co.
West Penn. Power Co.
Superior Water, Light & Power Co.
Ottertail Power Co.
Cliffs Power & Light Co.
Washington Water Power Co.
Iowa Public Service Co.
N. Dakota Power & Light Co.
Missouri Utilities Co.
City of Los Angeles Water & Power

It will pay you to consider Riley equipment because Riley gives you more for your money.

A survey of your Power Plant by a consulting engineer will possibly show ways of making surprisingly large savings in your power costs

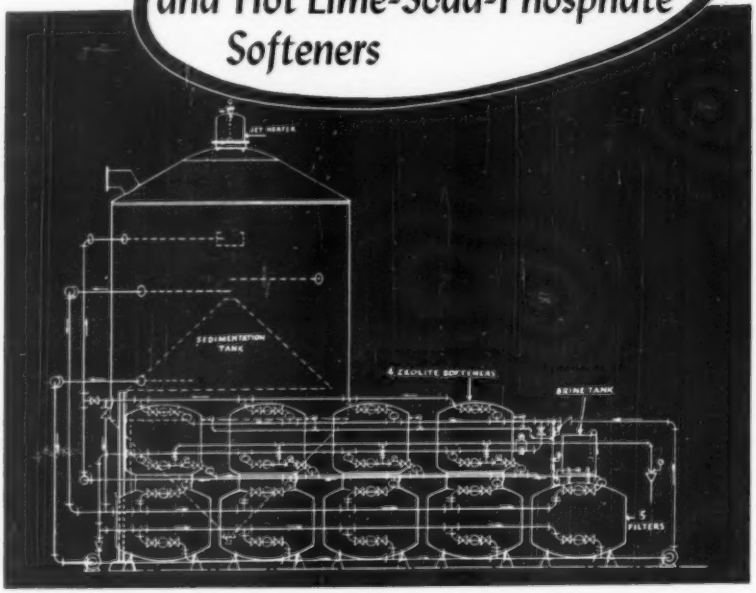
COMPLETE STEAM GENERATING UNITS

. . . it will pay you to visit modern Riley Installations before purchasing Boiler or Fuel Burning Equipment

ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • AIR HEATERS

Cochrane HOT Lime ZEOLITE Water Softener

A Suggestion for Operators of Hot Lime-Soda and Hot Lime-Soda-Phosphate Softeners



The installation at the right shows a Cochrane Hot Lime-Zeolite Softener in a paper mill in the Northwest. The Zeolite Softeners are mounted on and supported by the filters in order to save space.

The introduction of Cochrane Hot Lime-Hot Zeolite Softeners presents an exceptional opportunity for increased capacity, with surprising savings in cost, to operators of conventional Hot Process Softeners who may be faced with expansion problems suddenly thrust upon them by today's production requirements. The conversion to Hot Lime-Hot Zeolite can be accomplished, in the case of Hot Lime-Soda Softeners by merely adding another settling tank to the existing settling tank, adding more filters, followed by a booster pump station discharging through a battery of Zeolite Softeners. In the case of two-stage softeners, the Hot Phosphate Tank is eliminated or may be used to double the first stage lime tank's capacity. More filters and a battery of Hot Zeolite units are added.

Cochrane Hot Lime-Zeolite Softeners are being installed in many expanding industries in all parts of the country.

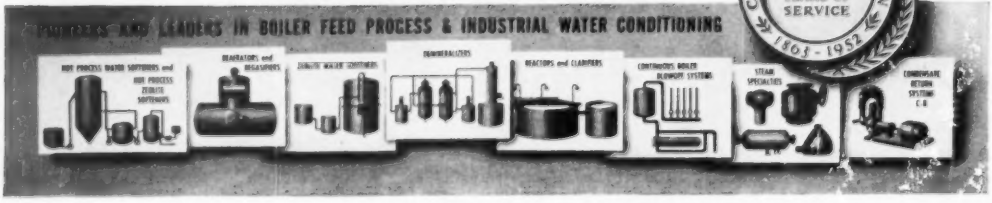
COCHRANE CORPORATION • 3123 N. 17th St. • Philadelphia 32, Pa.

In Canada: Canadian General Electric Co., Ltd., Toronto • In Mexico: Babcock & Wilcox de Mexico, S. A., Mexico City • In Europe: Recuperation Thermique & Epuration, Paris

COCHRANE

89 YEARS OF SERVICE 1863 - 1952

PIONEERS AND LEADERS IN BOILER FEED PROCESS & INDUSTRIAL WATER CONDITIONING

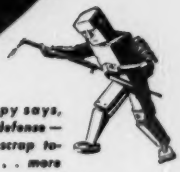


Remember the trademarks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

tt

TUBE-TURN

TRADE MARK



Scrappy says, "Aid defense — more scrap today . . . more steel tomorrow."

Engineered to reduce pressure loss

Write Dept. C-2 for free booklet on Allowable Working Pressures. Use coupon on reverse side.

• Looks simple, doesn't it . . . that welding fitting? Not so! It's *engineered* . . . for shape, for size, for dimensions, for wall thickness . . . all so that it will do its share of the piping job for you . . . without trouble and at top efficiency. True circularity, smooth inner walls, and full radius combine to reduce pressure loss of any flow of fluid. Micrometer-checked uniform wall thickness and forged-in strength combine to assure long-life, dependable service.

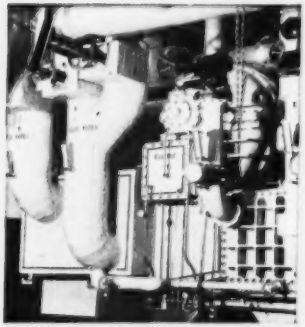
All TUBE-TURN Welding Fittings and Flanges are design *engineered* and held to extremely close manufacturing tolerances giving the utmost in strength, safety and efficiency. You'll find a TUBE TURNS' Distributor in every principal city. Call him for good service in good connections.

Be sure you see the double "tt"

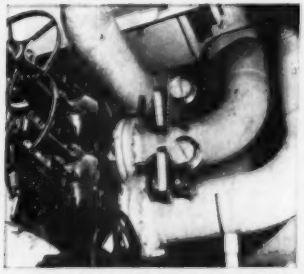
TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Chicago • Houston • Tulsa • San Francisco • Los Angeles
TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO... A wholly owned subsidiary of TUBE TURNS, INC.

Welded piping reduces maintenance for City within a City



Piping for refrigeration machines, ranging up to 14 inches, is trouble-free. Use of TUBE-TURN Welding Fittings also speeded up erection of piping, since most assemblies were shop-welded, then tied into the systems they serve. Insulation was applied easily and is permanent.



District heating plant supplies steam at 150 psi. Steam is then sent through headers fabricated with TUBE-TURN Welding Fittings ranging up to 12 inches, and distributed via steam stations. Optimum flow conditions have been obtained and maintenance overhead minimized.

● Service requirements for the Rockefeller Center group of 15 skyscrapers add up to big figures.

The Center consumes nearly half a billion pounds of steam each year.

The famous outdoor skating rink is kept in use even when temperatures are in the high sixties.

A total of 8,000 tons of refrigeration is available for air conditioning.

But maintenance on all the miles of piping is kept to a minimum. All critical piping systems are welded, and directional changes made with TUBE-TURN Welding Fittings. Thus piping is permanent and leakproof, and vital services are maintained without interruption.

Want Pressure Data?

Tube Turns, Inc. has prepared a booklet of pressure tables covering TUBE-TURN Welding Fittings in all sizes, weights, and regularly manufactured materials for Power, Oil, Heating, Gas, and Refrigeration Piping. If you'd like a copy, just mail the coupon.

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224 East Broadway, Louisville 1, Kentucky

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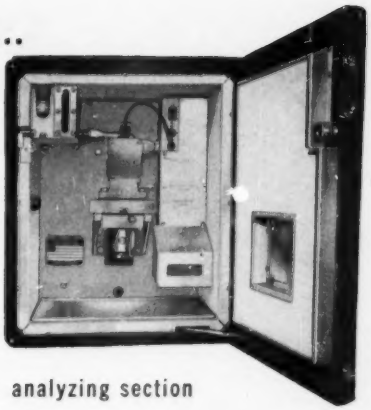
TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

for large industrial power plants and central stations...

a new CO_2 RECORDER using three established ideas



analyzing section

Designed to handle the CO_2 measurement problems of large industrial power plants and central stations the new *Hays Condu-Therm CO_2 Recorder* uses three established ideas:

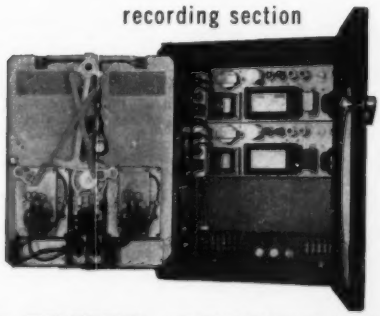
1. *The use of CO_2 measurement as a guide to combustion efficiency* . . . has been used by thousands of boiler plants and industrial furnaces, particularly where a single fuel such as natural gas, oil, bituminous or anthracite coal is being burned.

2. *The thermal conductivity principle of gas analysis* . . . has been accepted extensively in the process industries, because of its fast response to changes in gas composition, its freedom from chemicals, and its proven reliability.

3. *Electronic type operation* . . . frees the instrument of the step action and delicate construction commonly found in galvanometer operated instruments . . . also adds greater speed, power and magnification, while assuring high accuracy and permanency of calibration.

features five second response with ±.25% accuracy

recording section



the condu-therm features:

- ***5 second response to CO_2 change due to:***

  rapid change of sample gas in gas passage system

  small volume of gas in analyzing cell

  continuous connection (through amplifier) between analyzer and recording pen motor

- ***±.25% accuracy for chart ranges up to 0 to 20% due to:***

  slide wire construction . . . 5 tolerances held to .1%

  recording pen cam precision-machined to .0001 in.

  high power gain (2.5 million)

- ***"Boiler plant" construction unavailable in any other instrument:***

  linkage of ⅛" x ½" bar

  multiple pen bearing of telescoping stainless steel tubes

  oilite bearings do not require lubrication

  chart plate of ¼ in. permanent mold casting

  unit construction for easy replacement of each main element

For full information on the Hays Condu-Therm CO_2 Recorder write for Bulletin 51-1008 which includes:

detailed explanation of operation of analyzing and recording sections

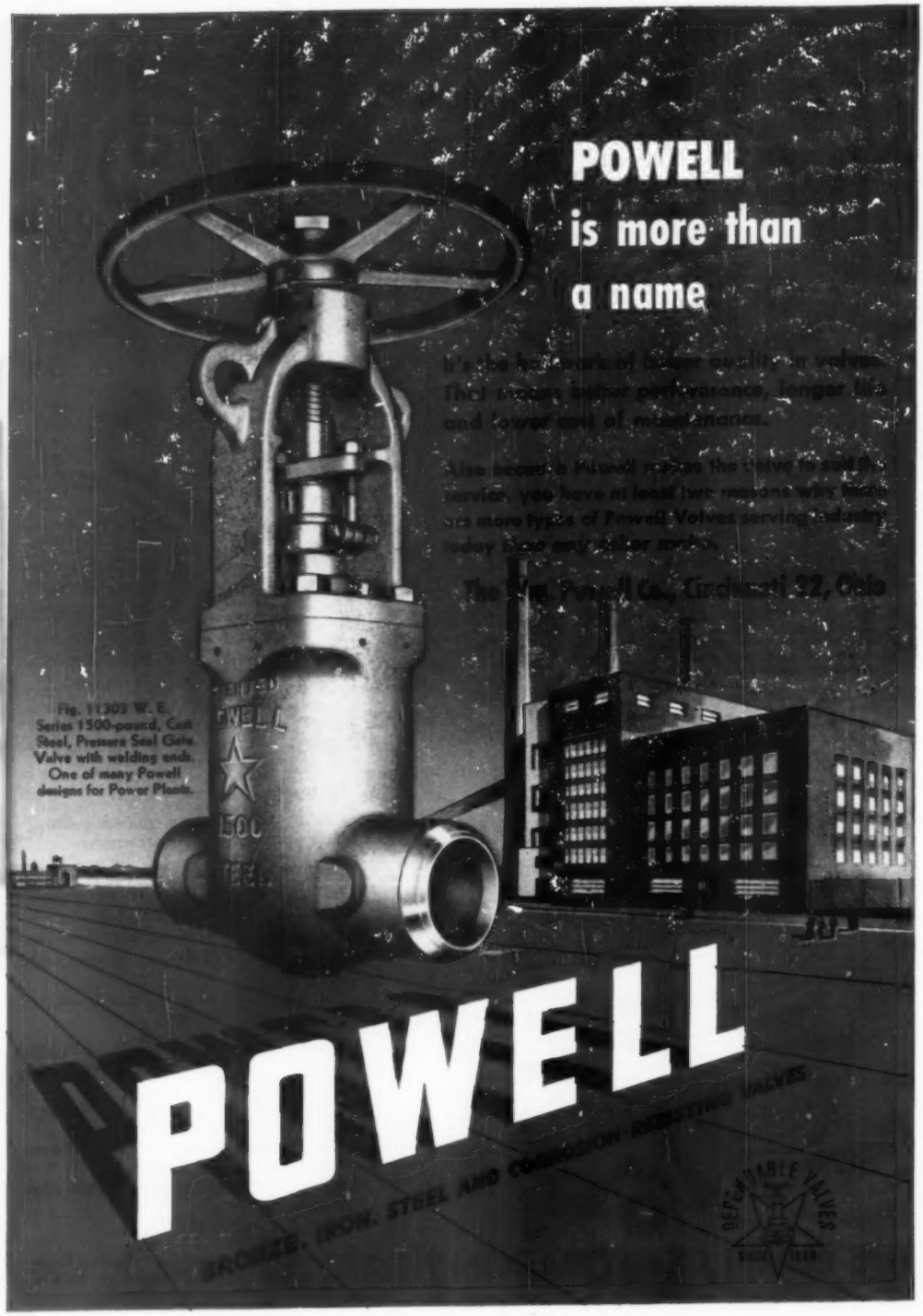
completely illustrated discussion of component parts and features

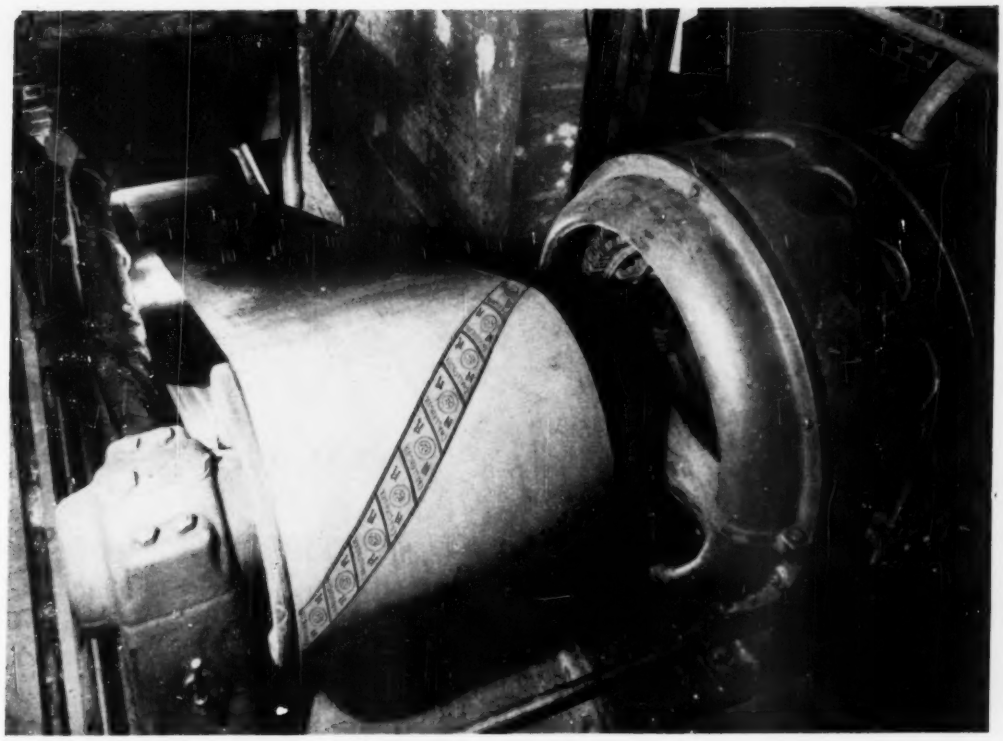
drawings of and information on gas sampling systems.

THE **HAYS** CORPORATION
MICHIGAN CITY 7, INDIANA

Automatic Combustion Control • Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol • Gas Analyzers • Draft Gages
Combustion Test Sets • CO_2 Recorders • Electronic Oxygen Recorders

City _____ State _____


POWELL
is more than
a name
Fig. 11303 W. E. Series 1500-pound, Cast Steel, Pressure Seal Gate Valve with welding ends. One of many Powell designs for Power Plants.
POWELL
BRONZE, IRON, STEEL AND CORROSION-RESISTING VALVES



for really efficient power transmission . . . it's Republic Rubber's *Challenger* Belting

No mistake about it. When it's a question of power delivery, the answer is Republic's Challenger Transmission Belting — the top performer of them all!

Challenger has been designed to handle your most difficult job. It's a flexible pre-stretched belt made of heavy, hard-woven, rubber-impregnated fabric for maximum service life. Challenger is an exceptional belt, being adaptable for long satisfactory service on heavy industrial drives subject to shocks and stresses, and also for drives operating at high speeds over small pulleys.

Challenger Belting is free from fastener trouble, and both top and bottom surfaces have special non-slip friction for better pulley traction. The edges are sealed against moisture, fumes and other deteriorating factors. Challenger is also fabricated with heat-resisting compounds for special operating conditions.

Standard plies and widths are available in roll lengths or tailor-made to specified endless lengths. Consult your nearby Republic Distributor today about your particular needs.

Remember, Republic Rubber has been *the* specialist in the mechanical rubber goods field for more than 48 years.

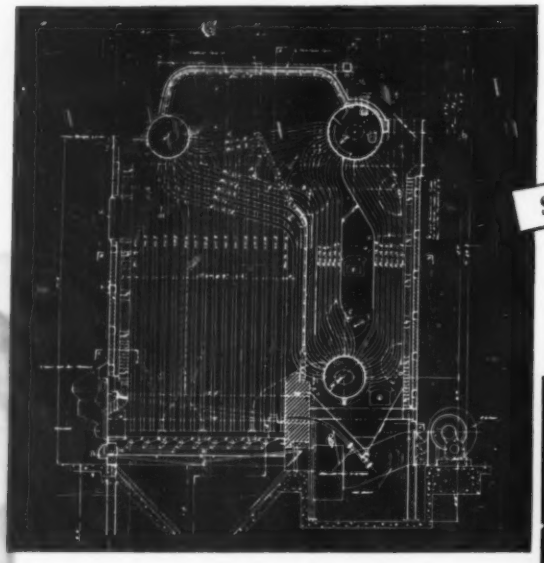
INDUSTRIAL RUBBER PRODUCTS BY

REPUBLIC RUBBER DIVISION

Lee Rubber & Tire Corporation

YOUNGSTOWN, OHIO

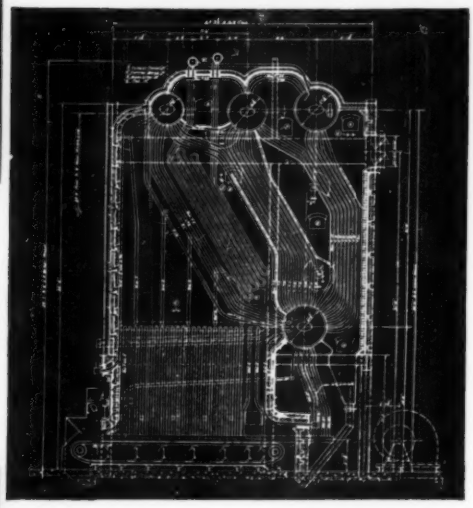
Quick Steaming at all Ratings!



Carry high overloads with high efficiency

SPECIFY Vogt

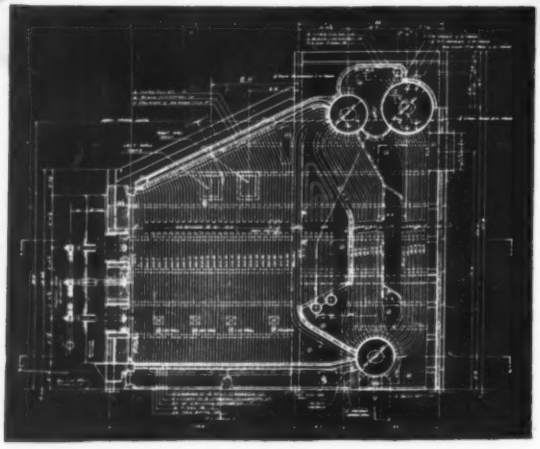
STEAM GENERATING UNITS



CLASS VL Two 27,500 pounds per hour units, installed at Brown-Forman Distillers Corporation, Louisville, Ky. Features large furnace volume in limited space, with high ratio of radiant heating surface.

CLASS LE Mt. Carmel Public Utility, Mt. Carmel, Illinois, is served by this 60,000 pounds per hour unit. Generous steam liberating surfaces and steam space permit wide fluctuations in load.

CLASS VR 70,000 pounds per hour steam generator at Humble Oil and Refining Company, Johnsue, Texas. An efficient, high-duty unit with water cooled furnace, using refinery gas fuel.

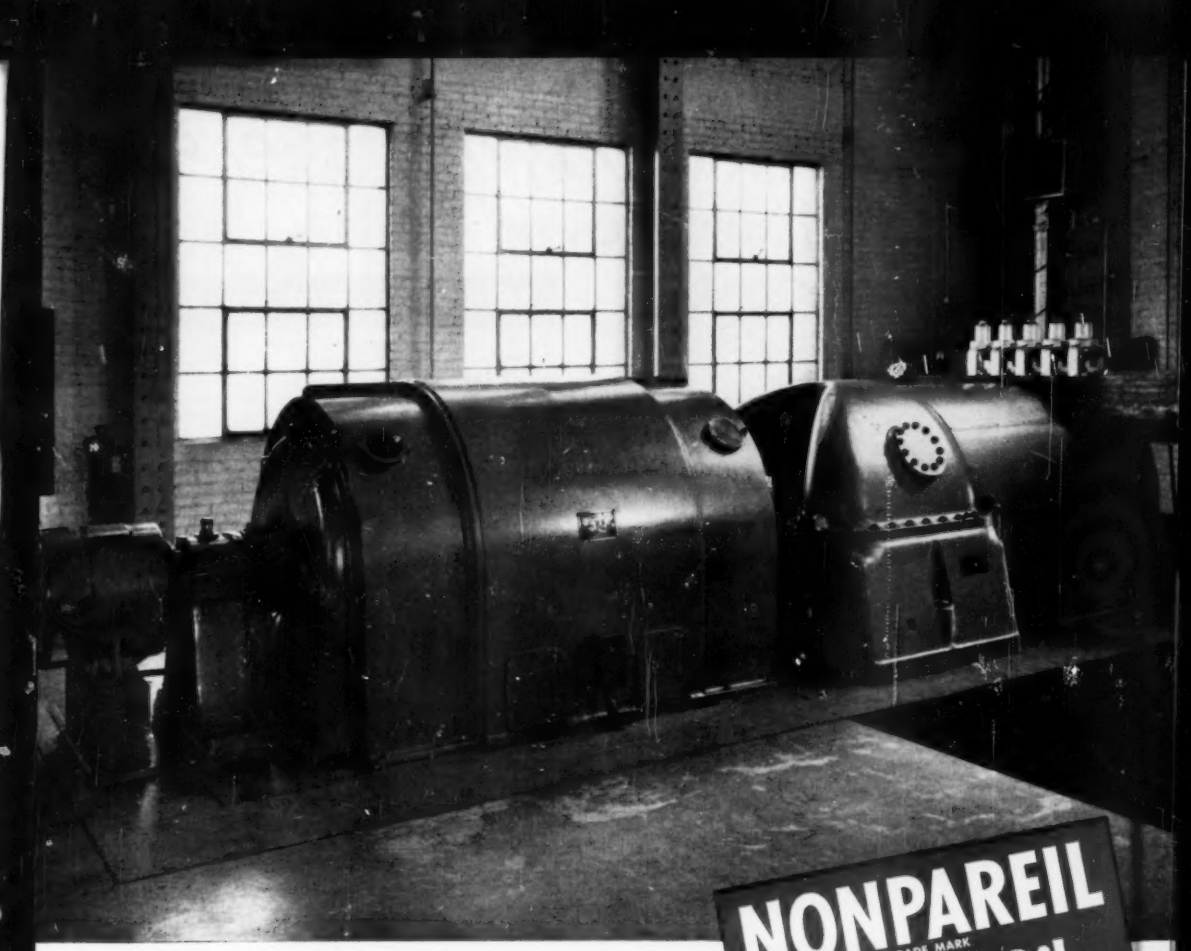


Vogt builds a complete line of bent tube steam generators, designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Superheaters, air preheaters, economizers, water walls, and soot blowers can be readily incorporated. Bulletins with general information and showing typical installations are available upon request.

HENRY VOGT MACHINE CO.

LOUISVILLE 10, KENTUCKY

BRANCH OFFICES:
NEW YORK, PHILADELPHIA, CLEVELAND
CHICAGO, ST. LOUIS, DALLAS



NONPAREIL TRADE MARK **Turbine Oil**

12-year-old oil...good as new

• When a midwest municipality placed this equipment in service back in 1939, NONPAREIL Turbine Oil made up the original fill. During this 12 years of service the acidity number has never exceeded 0.09 mg. KOH/gm. Low acidity has meant low turbine maintenance costs. Make-up requirements have remained at a minimum.

When a second turbine was installed in 1950, NONPAREIL's performance record left no question in the minds of plant operators concerning the selection of an oil. NONPAREIL again made up the original fill. As in every case, these plant operators received a written guarantee that NONPAREIL would last as long as the turbine itself—that it would never exceed an acidity of 0.15 mg. KOH/gm.

For your own turbine installation, new equipment or old, operating economy begins with the installation of NONPAREIL Turbine Oil. A Standard Oil lubrication specialist can show you records covering up to 23 years of continuous operation with NONPAREIL Turbine Oil, and he can show you how to put the advantages of NONPAREIL Turbine Oil to work in your own plant. Call your nearest Standard Oil Company office, or write: Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois.

STANDARD OIL COMPANY

STANDARD *(Indiana)*

How to Avoid *JOINT TROUBLE* In Furnaces or Kilns

Norton RA1019 Alundum* cement is recommended for laying up either silicon carbide or fused alumina bricks and blocks. It assures strong, thin refractory joints.

If your furnace or kiln walls weaken at the joints first, there are several possible causes. The cement may not be refractory enough and shrink excessively. It may be too coarse. The joint may be too thick.

What's the solution? Many users of refractory shapes have found that Norton RA1019 Alundum cement used in conjunction with Norton Crystolon* or Alundum brick make a combination that adds extra life to furnace and kiln walls.

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

RA1019 ALUNDUM CEMENT

For most installations, users agree, you can't go wrong with Norton RA1019 Alundum cement for laying up either silicon carbide or fused alumina brick. This fine-grained, chemically stable cement, containing 80% fused alumina, matures at 1850°F and withstands temperatures up to 3100°F.

Here's how to use it. Dry-mix it before you add water to redistribute the bond and fines that may have settled out during shipment or storage. Then add enough water to make a slip just heavy enough to be troweled. Remember to stir it a bit every time you dip your trowel into it. Tap each brick into place . . . and you'll get thin, smooth joints that can really take it.

In cases, however, where a silicon carbide cement is mandatory — as in zinc and zinc oxide furnaces — Norton RC1130 Crystolon cement has proved eminently satisfactory.

CRYSTOLON BRICK

For lining forge furnaces and as piers and supports in oil- and gas-fired furnaces — where the use of fire clay is impracticable — Norton Crystolon refractory brick have piled up handsome performance records. It's not surprising. These silicon carbide brick are highly refractory (decompose at 4082° F) and highly resistant to thermal shock. They show no deformation under loads of 50 psi at 1500° C and no shrinkage at temperatures up to 2732° F. Their smooth surfaces lend themselves admirably to thin, smooth joints.

ALUNDUM BRICK

Where resistance to oxidation and basic slags is the determining factor in your choice of refractory, Norton Alundum brick are recommended over silicon carbide. Made of chemically stable fused alumina in percentages ranging from 92.0 to 99.5 depending on the grade, Norton Alundum brick are highly refractory, usable at temperatures up to 3350° F.

NORTON

TRADE MARK REG. U. S. PAT. OFF.

Special REFRACTORIES

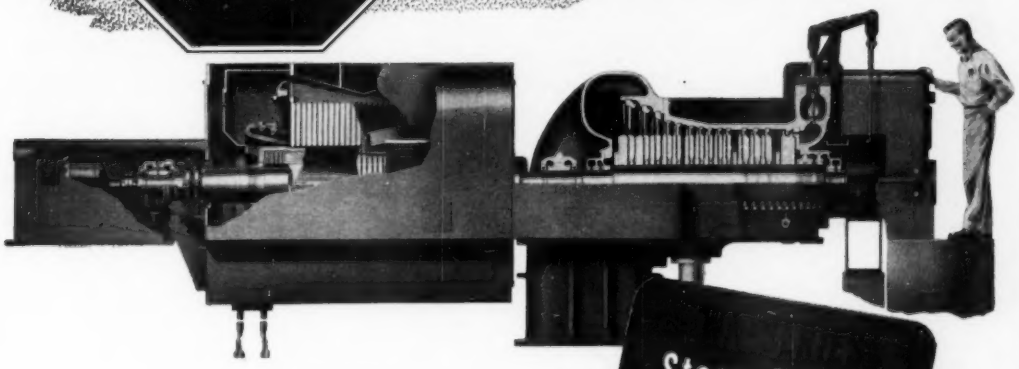
Making better products to make other products better

GET ALL THE FACTS

Two new Norton Bulletins — packed with factual data on refractory cement and brick selection — are yours for the asking. Contact your nearby Norton representative or write for Bulletins 863 and 862.

NORTON COMPANY
617 New Bond Street
Worcester 6, Mass.

END ..Generation Worries!



INSTALL MODERN EQUIPMENT

COMING DAYS of higher process steam and power demand will make power plant outages doubly hard to bear. Where will *you* be in this picture? Prepared with modern equipment to carry this severe load? Or just hoping for the best with outworn and outmoded equipment.

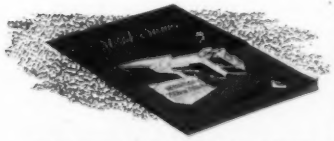
Truly modern WA-Series steam turbine generating units are already generating power and can be working for you sooner than you think. They are supplied in a wide range of NEMA ratings through 7500 kw, for either condensing or non-condensing service, with or without automatic extraction.

The accurate, reliable centrifugal type speed governor is the same kind used by Allis-Chalmers on its large steam and hydraulic turbines. The governing system incorporates oil pressure and if turbine system oil pressure should drop for any reason, the main throttle and inlet valves will close immediately, safeguarding the unit.

And just as in the larger Allis-Chalmers steam turbines ranging to 150,000 kw, trouble-free labyrinth steam seals are used for glands and interstage packing. Gland casings, moreover, are removable without disturbing the turbine casing.

These modern generating units are functionally attractive and completely coordinated in design. Impulse turbine, housing type air-cooled generator, and exciter are designed, manufactured, assembled, and tested under one supervision at one plant.

Get the *full* story on the quality features in the modern WA-Series! Be sure *your* next generating unit is up to date. Call your nearest A-C office or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3330



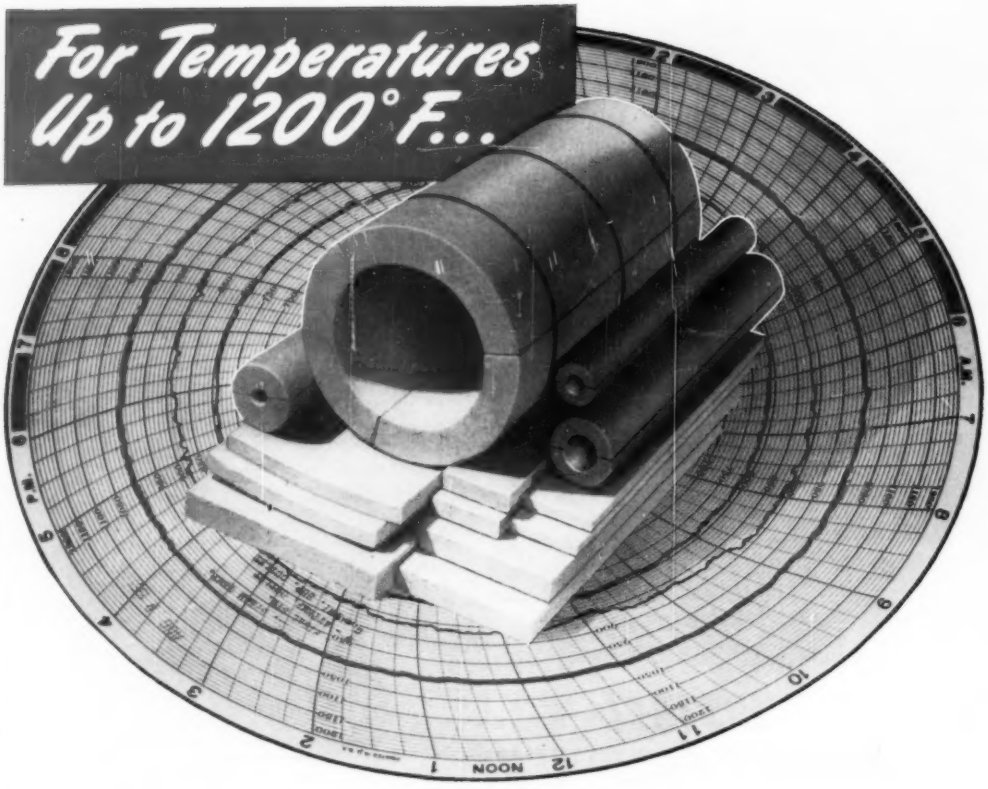
BULLETIN NOW AVAILABLE!
Ask for WA-Series Bulletin 03B7654

ALLIS-CHALMERS

TURBINES & GENERATORS | CONDENSERS & PUMPS | SWITCHGEAR & BREAKERS | MOTORS & CONTROL | TRANSFORMERS | WATER CONDITIONING

World's Widest Range of Power Plant Equipment

For Temperatures Up to 1200°F...



One Material Insulates The Entire Job — Better

Wherever the saving of heat is a factor . . . for temperatures all the way up into the superheated range, *one* material provides outstanding performance—Kaylo Heat Insulation.

The structure of this revolutionary heat-saving material, a hydrous calcium silicate, is composed of countless sub-microscopic air spaces giving it high insulating value. Its wide *effective* temperature range—up to 1200°F.—eliminates the need for combination coverings in nearly all operating conditions.

Kaylo Heat Insulation is inorganic, incombustible and insoluble in water; has remarkable dimensional stability—properties which contribute to its continued efficiency and long service life.

The high strength of Kaylo Heat Insulation makes spoilage almost negligible, in transit and on the job. Although Kaylo Heat Insulation is strong, it is extremely lightweight. Its ease of handling, cutting and fitting helps speed application.

For complete details on Kaylo Heat Insulation, write Dept. N-279, Owens-Illinois Glass Company, Kaylo Division, Toledo 1, Ohio.

See our CATALOG in

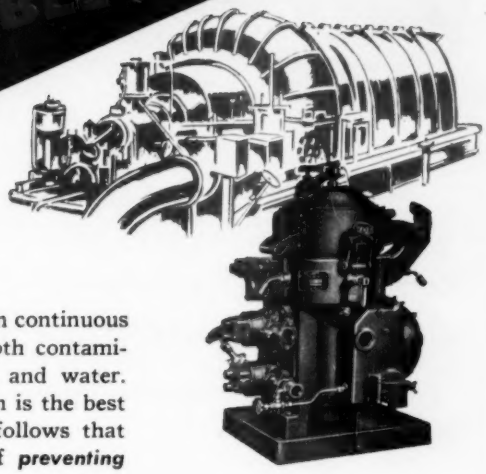
KAYLO® **... first in calcium silicate**

...pioneered by OWENS ILLINOIS Glass Company

MAIN OFFICE: TOLEDO 1, OHIO—KAYLO SALES OFFICES: ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND DETROIT • HOUSTON • MINNEAPOLIS • NEW YORK • OKLAHOMA CITY • PHILADELPHIA • PITTSBURGH • ST. LOUIS • WASHINGTON

A DE LAVAL OIL PURIFIER

KEEPS TURBINES OUT OF TROUBLE



A De Laval Centrifugal Oil Purifier, on continuous by-pass, keeps the turbine oil free of both contaminants that tend to cause trouble—dirt and water. Since a perfectly clean lubrication system is the best protection that a turbine can have, it follows that a De Laval Oil Purifier is a means of ***preventing*** turbine trouble.

De Laval machines, by means of centrifugal force applied most advantageously in the large-diameter bowl that characterizes De Laval construction, remove all solid and liquid contaminants. The solids are stored in the bowl where they cannot recontaminate the oil; the water is discharged continuously.

If a water leak should ever occur, a De Laval unit will prevent serious damage, for all De Laval Oil Purifiers properly selected for size in the first place have ample reserve capacity to keep the oil dry until repairs can be made.

THE DE LAVAL SEPARATOR COMPANY
Poughkeepsie, New York 427 Randolph St., Chicago 6
DE LAVAL PACIFIC CO., 61 Beale St., San Francisco 5
THE DE LAVAL COMPANY, Limited, Peterborough, Ont.

DE LAVAL

LUBRICATING OIL PURIFIERS

Could You Use SAVINGS *Like These?*

40% less
Fuel Consumption
50% more
Boiler Capacity

Bailey Meters and Controls Insure Savings at Kerr Bleaching & Finishing Works, Concord, N. C.

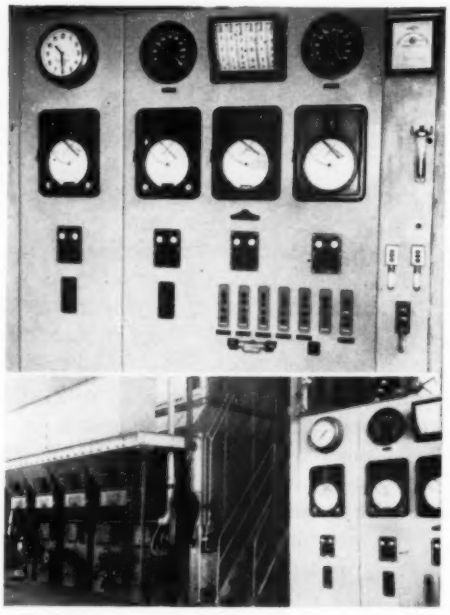
The key to complete returns on any investment in new power equipment is a fully co-ordinated system of meters and controls. It's the old story, the tail that wags the dog—careful attention to this comparatively minor part of the over-all installation cost can mean the difference between profit and loss in operation.

Here's where Kerr Bleaching & Finishing Works has cut operating costs—by installing *co-ordinated* Bailey Meters and Controls. The installation includes Bailey Meter Combustion Control, and Bailey Two-element Feed Water Control.

Such a co-ordinated system is an important plus for Bailey customers. Nowhere else can you buy such a complete range of equipment, selected without bias to do the best job for you. Nowhere else can you find such expert engineering service, immediately available through conveniently located direct sales and service representation. May we help you?

Call our local branch office or write for Bulletin 15-H.

A-113



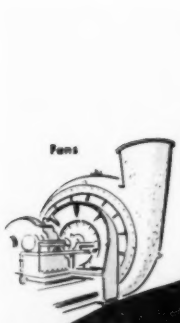
Control panel, showing completely co-ordinated Bailey Meters and Controls at Kerr Bleaching and Finishing Works, Concord, N. C.

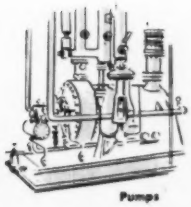
BAILEY METER COMPANY

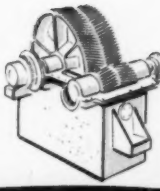
BAILEY METERS

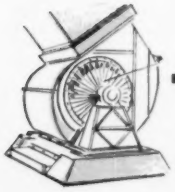
1040 IVANHOE ROAD
CLEVELAND 10, OHIO

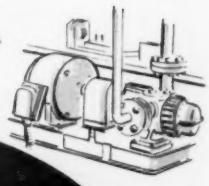
Controls for Steam Plants
COMBUSTION · FEED WATER
TEMPERATURE · PRESSURE
LIQUID LEVEL · FEED PUMPS



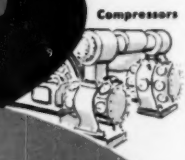




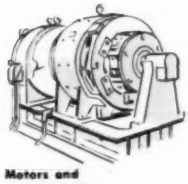




How many oils do you use for auxiliary plant equipment ?



You need only GULF HARMONY OIL



—Outstanding many-purpose oil for equipment like this!

You can lubricate all your plant auxiliary equipment better with just this one oil—Gulf Harmony Oil. It's equally effective for sleeve-type and antifriction bearings, hydraulic mechanisms, compressor cylinders, and many types of gears.

Here are a few of the many reasons why Gulf Harmony Oil performs so well in so many different applications. First, it has high resistance to oxidation and the formation of sludge. In oil circulating systems, reservoirs, hydraulic systems, and antifriction bearing pedestals, this means freedom from harmful deposits and insures against premature oil changes.

Then the lubricating film provided by Gulf Harmony Oil has preferential wetting characteristics for metal—it displaces moisture, interrupts its corrosive action. That's how this quality oil prevents rust on all oil-bathed surfaces—a particularly important function in precision hydraulic valves and in antifriction bearings operating under damp conditions.

And because it has good water-separating characteristics, there is less chance of emulsification and the useful life of each fill is prolonged.

Gulf Harmony Oil is available in a wide range of viscosities and is inhibited to provide more effective protection against wear under boundary conditions.

For further information on Gulf Harmony Oil and for expert help on your lubrication problems, call in a Gulf Lubrication Engineer today. Write, wire, or phone your nearest Gulf office.

Gulf Oil Corporation · Gulf Refining Company,
Gulf Building, Pittsburgh 30, Pa.

GULF INDUSTRIAL LUBRICATION

● Super-Silvertop Steam Traps pay for themselves because they are installed and serviced so much faster and easier than any other trap. Look how the Super-Silvertop design provides for 3 pipe connections in the head so that you can easily install the trap as an elbow or straight-in-line. This feature, standard on all Super-Silvertops, eliminates "jungle" piping that accompanies traps with only 2 pipe connections . . . actually saves up to 7 fittings plus 50 minutes installation time over conventional traps.

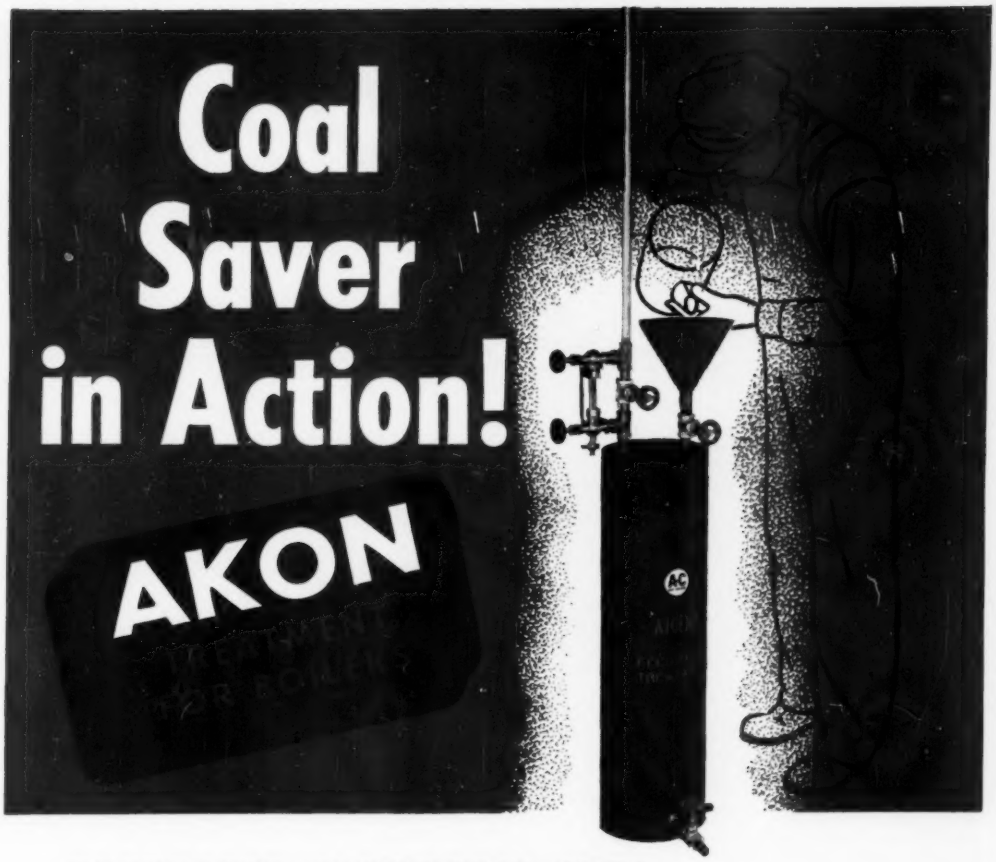
Good preventive maintenance calls for periodic steam trap inspection. To inspect any Super-Silvertop, you simply loosen and remove the body . . . no pipe fittings to disconnect before you can get to the inside of the trap. These two features, plus the patented guided bucket that eliminates sloppy bucket action and damage, are the reasons why more and more plants are standardizing on Super-Silvertops. Buy the trap that pays for itself. See your local Super-Silvertop distributor about selecting the right trap for your requirements.

FREE *THIS FAMOUS SUPER-SILVERTOP BOOK is yours for the asking. Explains how to select the right steam trap for any installation. Many useful maintenance helps. Write for your copy of "Solving Steam Trap Problems" today.*

THE V. D. ANDERSON COMPANY
1977 WEST 96TH STREET • CLEVELAND 2, OHIO
In Canada: Bawden Industries, Ltd., Toronto

SUPER-SILVERTOP STEAM TRAPS

Coal Saver in Action!



DECREASED BLOWDOWN CUTS FUEL COST FOR BOILERS

BOILER BLOWDOWN wastes many tons of your coal every month.

The primary job of *Akon* treatment is to keep that waste at a minimum. *Akon* treatment takes sludge particles out of circulation harmlessly, forming *non-adherent* flocs which can be removed by less blowdown than would otherwise be required. In turn, less blowdown means savings in coal, water and chemicals . . . and no sludge deposits remain.

Akon treatment is also an excellent oxygen absorbent; it effectively scavenges traces of oxygen not removed by deaerators. Thus, both corrosion and the ills due to sludge are corrected by this one treatment.

Give your boilers the treatment they deserve. For sludge control and oxygen scavenging, use *Akon* treatment for boilers.

Akon is an Allis-Chalmers trademark.

ALLIS-CHALMERS

Water Conditioning

✓EQUIPMENT ✓CHEMICALS ✓SERVICE

SEND FOR the two Allis-Chalmers bulletins, BLOWDOWN (No. 28X7731) and *AKON* (No. 28B7408). In these concisely written bulletins you will find material helpful in training personnel for your power plant and valuable information on blowdown problems.

Allis-Chalmers
Milwaukee 1, Wisconsin

Gentlemen:

Please send me bulletin number
☐ 28X7731 on Blowdown
☐ 28B7408 on Akon treatment

Name

Title

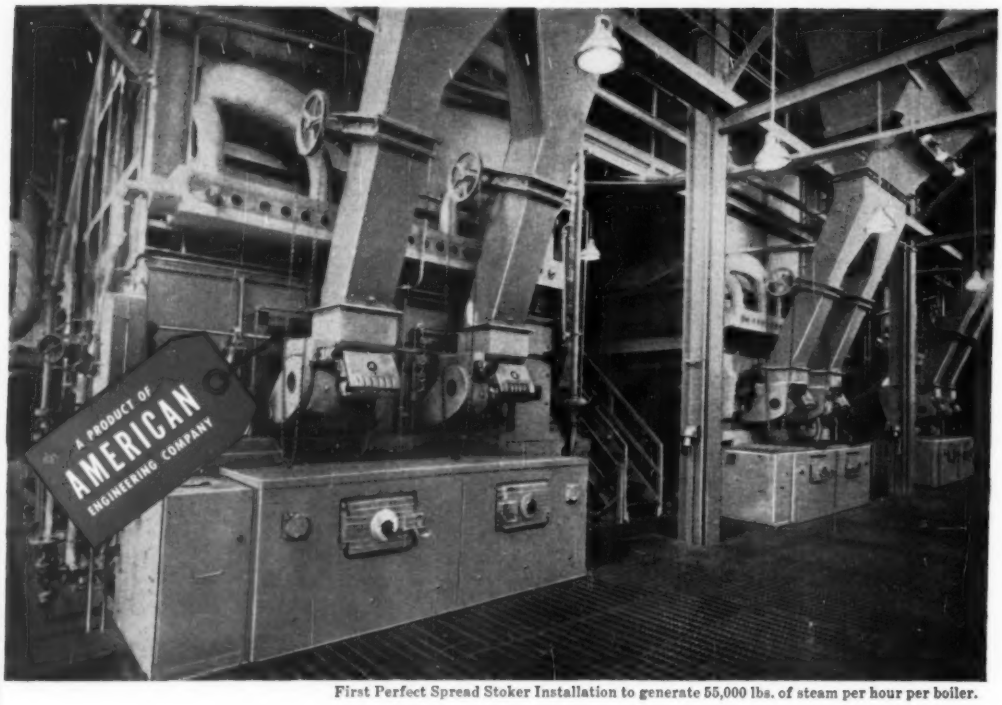
Company

Address

City State

A-3539

1... 2... and now a 3rd order for



First Perfect Spread Stoker Installation to generate 55,000 lbs. of steam per hour per boiler.

Day and night, for weeks at a time, Spreader Stoker continuously releases 700,000 B.T.U. per hour per square foot of active grate area

1 IN THE FALL of 1949 a very well known corporation installed three AE Perfect Spread Stokers to generate 55,000 lbs. of steam per hour each in one of its midwest plants.

2 Months later the Company needed more steam from larger boilers in another plant where the existing stokers had been designed to burn 12,300 B.T.U. per pound coal. Over the years, however, the available coal dropped to as low as 9500 B.T.U. per pound so the plant could not carry the required load.

On the basis of proved performance, an AE Perfect Spread Stoker was installed as a replacement... and here's the record:

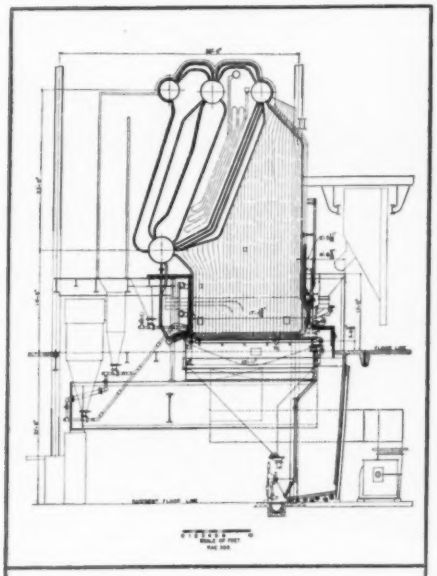
The Perfect Spread has averaged better than 180,000 lbs. of steam per hour—24 hours a day—7 days a week for weeks on end. Efficiency is about 84% and the release rate exceeds 700,000 B.T.U. per sq. ft. of active grate area per hour! In terms of sustained results per sq. ft. of grate surface this is probably the highest duty spreader stoker installation in the world. With an increased manufacturing load they now find they can carry 200,000 lbs. per hour.

3 And now, again on the basis of performance, the same company has ordered two more duplicate Perfect Spread Stokers.*

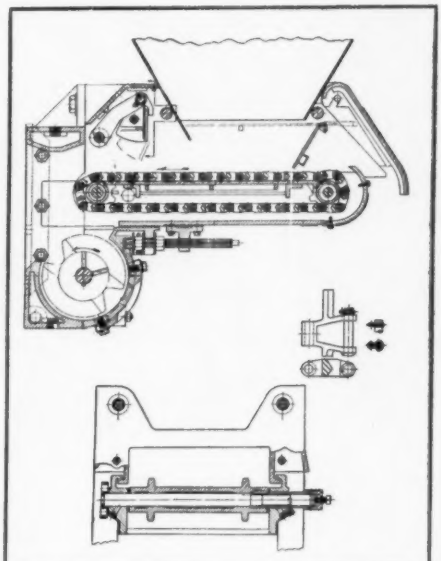
AE Perfect Spread Stokers burn high and low ash coals with practically equal efficiency. They assure positive, continuous coal feed and unbe-

*AS THIS MESSAGE WAS GOING TO PRESS, THE ABOVE COMPANY PLACED A FOURTH ORDER FOR A PERFECT SPREAD STOKER.

PERFECT SPREAD STOKERS



Second larger installation of Perfect Spread Stoker actually giving 200,000 lbs. of steam per hour from a single boiler.



NON-CLOGGING CONVEYOR FEEDER: Coal enters feeder from hopper, and is conveyed positively, continuously and uniformly forward. Coal is not fed in slugs.

lieveably even distribution. *They never clog on wet coal.*

Perfect Spread Stokers have a capacity range from 8,000 to 500,000 lbs. of steam per hour... coal feeders are adjustable from 50 lbs. to 7500 lbs. of coal per hour. Mail coupon today for a copy of the Perfect Spread Stoker booklet and for a reprint of a new report on large spreader stokers. Also, if you are now considering a boiler in capacities from 300,000 to 500,000 lbs. of steam per hour, let's arrange to get together and discuss cross-firing.

WON'T CLOG ON WET COAL

AMERICAN ENGINEERING
COMPANY
PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers.

American Engineering Company
2408 Aramingo Avenue
Philadelphia 25, Penna.

Gentlemen: Kindly send me free copy of Perfect Spread Stoker booklet and new stoker report ☐. I should like to discuss cross-firing ☐.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State____

Photomicrograph of one type of silica scale in early formation stage. Further deposits will fill in between the "trees" to form a dense, glass-hard, insulating covering that is extremely difficult to remove—and impervious to usual water treatment techniques.

STONE FOREST

(The boiler scale that fought back)

● When silica scale was mentioned, water-treatment experts used to change the subject quickly . . . until a plant using The Nalco System began having scaling troubles due to high silica content of the raw water.

That was many years ago. Today, the same plant, operating at 135 psi, maintains 500 ppm (29.4 grains per gallon) silica in boiler water without scaling.

The Nalco research program that solved this low-pressure boiler water silica problem is a continuous one, so that today The Nalco System successfully meets the challenge of silica wherever it arises in the field of water conditioning.

Whether your water treatment problem is silica—or something even tougher—Nalco has the solution, or can put the full facilities of the Nalco Laboratories to work on it for you.

LATEST STUDY ON SILICA CARRY-OVER

At operating pressures over 400 psi another silica problem—that of silica carry-over—often arises. One of the 1951 ASME papers, "Correlation of Silica Carry-over and Solubility Studies" is an up-to-the-minute, informative discussion of this problem. You are welcome to a copy. Just write to National Aluminate Corporation.

NATIONAL ALUMINATE CORPORATION
6224 W. 66th Place • Chicago 38, Illinois
Canadian inquiries should be addressed to Alchem Limited, Burlington, Ontario

THE Nalco® SYSTEM . . . Serving Industry through Practical Applied Science

Helpful Bulletins

THE ANSWERS to many of your operating and maintenance problems are found in these new and recently revised catalogs and bulletins. List the paragraph numbers of those you want on the card below, detach and mail

INSTRUMENTS AND CONTROLS

101 Potentiometer Characteristics — Here are two of a recently released series of publications covering adaptation and utilization of this equipment to specialized applications. Bulletin B15-12 describes the Brown Electronik continuous balance system, giving details of the circuit and discussing component characteristics of amplifier and motor combination. Bulletin B15-13 discusses characteristics of measuring circuits used in the Brown Electronik potentiometer. Ask for either bulletin, or both. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

102 Specialized Level Gage — A remote reading liquid level gage for measuring levels of greater variation length than usually encountered in steam boilers is described and pictured in Section C5.1 of Catalog 500. Tells advantages of this gage which is adaptable for wall or panel mounting, gives installation suggestions. The Reliance Gauge Column Co.

103 Ask the Man Who Uses One — Case histories of engineers, maintenancemen, electricians and others who use company's Amprobe Snap-around Volt Ammeter are presented in 16-pp Manual 504. Illustrated by cartoons and told in the words of the men who handled the work, these actual experiences show how the Amprobe can save time and effort in locating trouble and preventing shutdowns. A working drawing of the Amprobe and specifications included. Pyramid Instrument Corp.

104 Thermocouple Wells — Catalog 200-1 provides 28 pp of technical information on the selection of the proper well for any given application. Curves are provided to show the method of selecting correct shape and thickness. Information is also provided on choice of well material. Photos and dimensional drawings of all of manufacturer's standard thermocouple wells together with basic prices are shown. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

105 Where There's Smoke — Indicators and controls which provide a constant check on smoke density are described and pictured in this 2-pp bulletin. Discusses advantages of these photo-electric cell systems in terms of reduced smoke, improved furnace efficiency. Gives specifications. De-Tec-Tronic Laboratories, Inc.

106 Vane Type Controllers — Sixteen-pp Catalog 8000 describes vane type electric contact control units used with manufacturer's Electr-O-Vane thermometers and pressure gages, and with the Electronik potentiometer, as well as those used in Pyr-O-Vane and Protect-O-Vane millivoltmeters, to give snap-action, on-off, two position or three position control. Brown Instruments Div., Minneapolis-Honeywell Regulator Co.

108 To Prevent Winder's Cramp — This bulletin describes and pictures several models of company's Winder-Uppers designed for easy winding of meters, spring clocks, temperature controls etc. J. A. Campbell Co.

PACKINGS, SEALS

109 Asbestos Fabric Packings — This illustrated bulletin on asbestos packings provides service recommendations, sizes, packaging specifications for high pressure rubber back, high pressure rubber core, and high pressure dual edge packings. Packing Div., Raybestos-Manhattan, Inc.

110 Self-Lubricating Packings — Bulletin LP-10 illustrates nine self-lubricating packings, giving applications, structure and performance. These include braided, plaited and twisted types for general service, solvent service, alkali service, acid-handling pumps and valves, specialized uses. Lists sizes, weights. Greene, Tweed & Co.

111 Seals for Bearings — Complete information on manufacturer's Klosure oil and grease seals for bearings is available in 100-pp Catalog 10. Fully illustrated in color, pictures all types of these seals, typical applications and lists sizes and part numbers. Also describes in detail mechanical pressure seals for rotary shafts. The Garlock Packing Co.

PUMPS, COMPRESSORS

112 General Purpose Pumps — Six-pp Bulletin 52B6351B presents a pedestal mounted pump in capacities to 2500 gpm for temperatures to 250 F and designed for direct coupling or V-belt drive. Cutaway illustration shows construction, sketches show pedestal arrangements. Dimensions included. Allis-Chalmers Mfg. Co.

113 Small and Submersible — Bulletin 51-5300 describes the Subette, smallest of company's submersible pumps and designed for small capacities at high heads from wells of 6 in. ID or larger. Gives capacity data; discusses simple installation, other advantages. Lists applications. Byron Jackson Co.

114 Jet Pumps — Featuring an illustrated explanation of the principle of jet pump operation, 20-pp Bulletin 512 discusses advantages of jet pumps, their operation by steam, air and fluids. Ejectors, eductors, exhausters and syphons are described and pictured along with dimensions, capacity data. Installation and maintenance tips are provided, applications listed. Penberthy Injector Co.

115 Self Priming Motor Pumps — Form 7240 describes and illustrates automatic operation and construction features of a new line of pumps, intended for pumping applications under suction lift where presence of air or vapor in liquid makes it impractical to use conventional-type centrifugal pumps. Includes selection chart, dimensional data. Ingersoll-Rand Co.

116 High Pressure Pumps — Catalog L-841, 28 pp, presents construction

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features and application information on company's four types of reciprocating power pumps. Specifications and dimensions given. John Bean Div., Food Machinery and Chemical Corp.

117 For Controlled Pumping — Illustrated Bulletin 251, 24 pp, is of special interest to engineers concerned with pumping practically any liquid from heavy viscous fluids to light solvents, solids in suspension, abrasive slurries, hot or cold liquids, liquefied gases. Describes company's motor-driven controlled volume pumps as well as models for special applications. Includes details on how capacity can be regulated by plunger speed and stroke adjustments. Capacity pressure selection tables provided. Milton Roy Co.

118 Air Compressors — Twelve-pp Form 300 presents an illustrated study of company's 35 air-cooled compressors for industrial use. Generously illustrated, includes specifications, explains construction features. Quincy Compressor Co.

119 Rotary Compressors — Bulletin C-6 offers up-to-date information on manufacturer's rotary compressors and vacuum pumps. Describes and illustrates intake regulator and end bearing and ring assemblies; explains operation. Fuller Co.

120 Motor-Driven Compressors — Fifty-pp Bulletin 118 is a new and attractively illustrated booklet covering manufacturer's balanced/opposed motor-driven compressors. Opening with an explanation of the balanced/opposed principle book shows, by an analysis of crankshaft design, how it saves space, affords greater accessibility, reduces maintenance and offers other advantages. Models of 8-, 14- and 17-in. stroke are presented. A cutaway illustration shows basic design, and major components of the compressors are covered in detail. Photos show installations. Clark Bros. Co., Inc.

121 Industrial Air Compressors — Complete engineering data covering manufacturer's Type M motor-driven compressors is available in Bulletin M-65. Compressors described range from 250 to 1000 hp with standard two-stage units and 300 to 1000 hp with standard single-stage units. Cuta way illustration shows design. The Cooper-Bessemer Corp.

VALVES, PIPING AND ACCESSORIES

122 Cast Steel Valves — Bulletin 5003, 16 pp, presents the design and operation, construction details, material specifications and pressure-temperature ratings of manufacturer's cast steel valves. Covers both taper seat wedge and double-disc parallel seat types. Darling Valve & Mfg. Co.

123 Valves for Boiler Services — Bulletin E125, 24 pp, describes company's quick-opening and slow-opening straightway valves, angle valves, Y valves and duplex blow-off units, with complete specifications, materials of construction and dimensions. Illustrations include design details, sectional and exploded views. Everlasting Valve Co.

124 Anti-Water-Hammer Valves — Bulletin WH-100 describes and illustrates manufacturer's flanged check valves designed not only to eliminate noises but also to prevent pressure surges which can result in damage to pipes, valves, liquids and other parts of piping systems. Includes technical data. The Williams Gauge Co.

125 Surge Relief Valve — Eight-pp Bulletin W-2 presents manufacturer's "cushioned" valve for protection of water lines against excessive pressures caused by surges in system. Stresses adaptability of valve, tells how it operates and is serviced. Illustrations include sectional drawings, installation arrangements. Specifications, given. Golden-Anderson Valve Specialty Co.

126 Rotating Pump Valve — Bulletin V-111 describes and pictures manufacturer's valve designed to "rotate its disc" and adaptable to practically all reciprocating pumps for a wide range of services. Illustrations show rotating disc principle, text stresses its advantages. Sims Pump Valve Co., Inc.

127 Steam Specialties — General Circular 715 illustrates and describes briefly company's separators, traps and boiler trim. Also lists specific literature available on each type of equipment. Wright-Austin Co.

128 Tube Fittings — Catalog B-151, 12 pp, describes and illustrates company's complete line of Swagelok tube fittings, available in brass, aluminum, steel, stainless steel and Monel. Complete dimensional information. Crawford Fitting Co.

129 Insulation Data — Bulletin 4 h, 8 pp, presents characteristics and advantages of company's Thermalite 85% Magnesia insulation for covering pipe, fittings and equipment. Tables include recommended thicknesses for various temperature ranges. Text summarizes recommended application procedure. Other insulations briefly described include a high-temperature insulation, insulating and finishing cements, asbestos sponge felt, air cell, hair felt, wick and rope. Ehret Magnesia Mfg. Co.

ELECTRICAL, LIGHTING

130 Control Switches — This 12-pp folder describes company's rotary packet switches which are custom built from standard components. Shows combinations available for controlling electrical circuits operating at current ratings from 10 to 500 amp and voltage ratings from 115 to 600 v a-c and up to 250 v d-c. Provides engineering data, ratings, dimensions, mounting types. The Arrow-Hart & Hegeman Electric Co.

131 Improved Voltage Regulators — The application, construction and operation of the new and more compact version of manufacturer's "Rocking Contact" voltage regulators are explained in Bulletin 14B6143A. The new unit is available in two ratings, Type V-00, with 34-step commutator, has maximum rating of 157 kva at 3600 rpm, and the Type 221, 50 steps, 438 kva at 3600 rpm. Special features described, construction, installation details illustrated. Allis-Chalmers Mfg. Co.

132 Motor Price List — Form EU-2 is a 40-pp vest-pocket catalog covering manufacturer's line of motors, brakes and transformers. Gives ratings, dimensions, application and operational data, current prices on equipment listed, also service and repair charges. Wagner Electric Corp.

133 To Surge-Test Windings — Bulletin GEC-321 describes an electronic tester for detecting insulation faults and

(*Continued on page 180*)

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HUDSON AVENUE STATION

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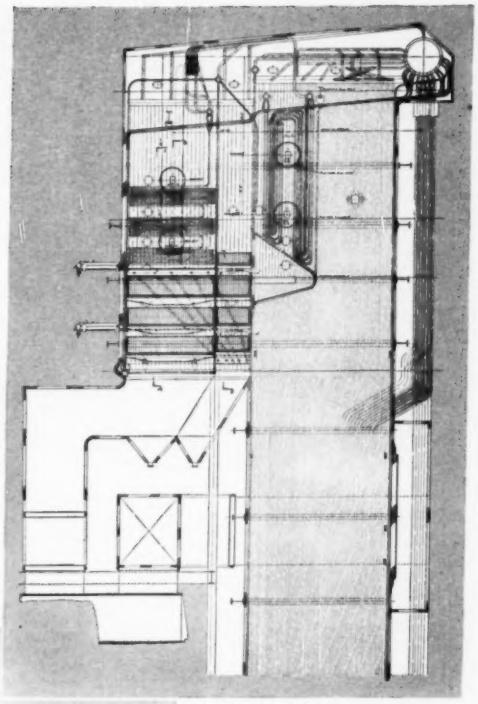


FOR the eighth time, Consolidated Edison Company of New York—world's largest public utility—has purchased Vulcan to keep an important boiler free from soot and slag. This time it's for Hudson Avenue Station, where the world's first 1,370,000-pounds-per-hour boiler is being erected.

The Vulcan Automatic-Sequential Soot Blowing System includes eighteen long retractables and two special air-heater cleaners all air-driven, all to blow with steam.

Whether you prefer to blow with air or steam, depend on Vulcan for optimum cleaning efficiency with low operating and maintenance costs. Let a Vulcan engineer show you how and why.

● B & W Radiant-Type Boiler fired with pulverized coal. Rated at 1,370,000 pounds of steam per hour at 1700 psi and 1050° F.

● 18 Vulcan long retractables, air driven, blow with steam under automatic sequential control.

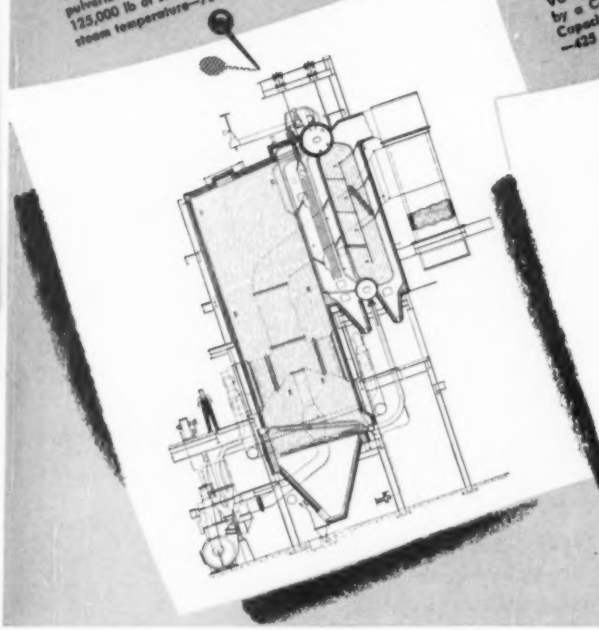
Showing structural work in progress at Hudson Avenue Station for one of the world's largest boilers.

VULCAN SOOT BLOWER DIVISION
Continental Foundry & Machine Company
DUBOIS, PENNSYLVANIA

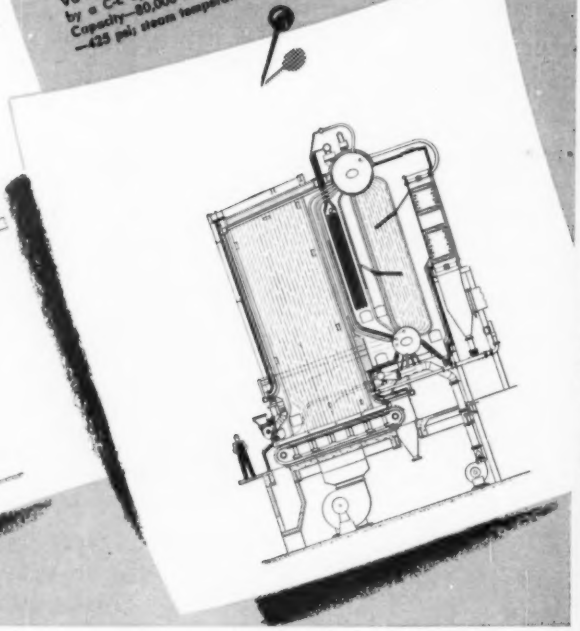
VULCAN *Automatic Soot* **BLOWERS**

How different are your Steam Requirements?

VU installation in a STEEL PLANT. This unit is fired with pulverized coal and/or blast furnace gas. Capacity—125,000 lb of steam per hr; operating pressure—850 psi; steam temperature—750 F.

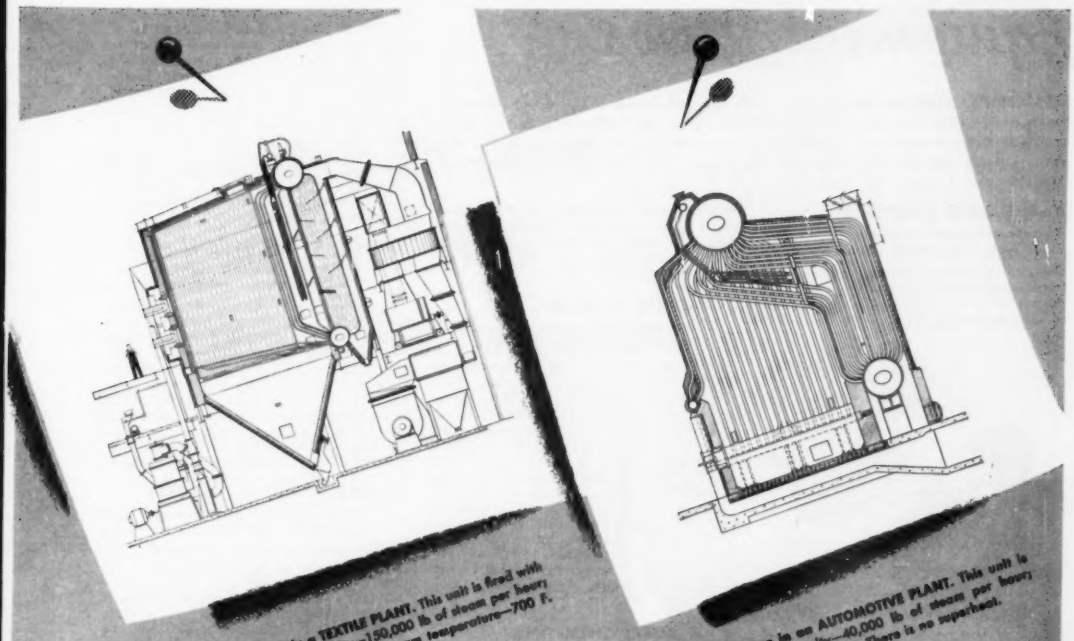


VU installation in a TOBACCO PLANT. This unit is fired by a C-E Spreader Stoker (continuous discharge type). Capacity—80,000 lb of steam per hr; operating pressure —425 psi; steam temperature—650 F.



COMBUSTION ENGINEERING

ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS AND AIR HEATERS



VU installation in a **TEXTILE PLANT.** This unit is fired with pulverized coal. Capacity—150,000 lb of steam per hour; operating pressure—600 psi; steam temperature—700 F.

VU installation in an **AUTOMOTIVE PLANT.** This unit is fired with oil. Capacity—40,000 lb of steam per hour; operating pressure—150 psi. There is no superheat.

Every engineer knows that steam requirements vary from industry to industry . . . from plant to plant. It is virtually certain, therefore, that your particular conditions of fuel, load, capacity, pressure and temperature are not exactly the same as those of any other plant.

Yet the C-E Vertical-Unit Boiler can deliver top performance in your plant . . . just as it has done in hundreds of others . . . representing a wide variety of steam conditions.

This is because the basic design of the VU allows exceptional latitude in the selection of the *right* boiler to fit your particular requirements. It is available in capacities from 10,000 to 350,000 lb of steam per hr, with pressures from 160 to 1000 psi and temperatures up to 900 F, or more. It is adaptable to limited space conditions and to the use of any fuel or method of firing. The VU may be operated over a wide range of output, and, depending on fuels and the use of heat recovery equipment, efficiencies range up to 88%.

How well is the Vertical-Unit Boiler meeting the steam requirements of different industries? The answer is to be found in an impressive record of orders and repeat orders covering virtually every field. If you would like first hand information on the story of the VU Unit in *your* industry we would be glad to send it to you.

* * *

The point is that the story is the same . . . in industry after industry . . . *the popularity of the C-E Vertical Unit Boiler is widespread and steadily increasing.* Why not investigate how the variables of your requirements can be matched with the VU Unit for top performance? 9-540

— SUPERHEATER, INC.

200 MADISON AVENUE, NEW YORK 16, N. Y.

C-E

Equipment News

SUMMARIZED HERE are new products and improved ones . . . recent developments of leading manufacturers who will gladly supply further information at no cost. You may use the no-obligation, postage-paid card on pages 37 and 38 for your request. Just list the numbers of the items you'd like to know more about

1—WELDING COUPLING

Is designed to eliminate welding scale from power piping systems

The SF Welding Coupling consists of two forged halves. The hub ends are prepared for welding to pipe or fittings of corresponding sizes. When the two

halves of the coupling are brought together the tongue of one slips into the groove of the other. A circumferential cavity directly beneath the beveled welding area serves to prevent burn-through or formation of icicles in the interior, to insulate the interior from extreme welding heat, and to prevent scaling.

Easy alignment of piping is made possible by the tongue and groove arrangement, company says, and because hubs are relatively short, scale or protrusions formed by the two attachment welds can be reached and removed before coupling is connected. When piping is to be disassembled, coupling can be taken apart and reused.

Suggested for use in connecting piping for high pressure steam, hydraulic fluids, compressed air, lubricating and fuel oils, this coupling comes in sizes from 1¼ to 12 in., in carbon steel, stainless steel, aluminum, other metals and alloys. Tube Turns, Inc.

2—SINGLE-STAGE TURBINE

For mechanical drive; is built with enclosed "shaft through" governor

Chief among design advantages announced for the Type H Steam Turbine is its "shaft-through" governor. This is a mechanical fly-ball type fully enclosed in a cast housing. The turbine shaft, virtually full diameter, is carried clear through the governor, providing extreme rigidity. This design permits double end drive, it is explained, and use of hand or direct driven electric tachometer, oil pump for pressure lubrication or oil relay for driving other accessories. Governor can be removed as a unit or dismounted on the shaft. Lubrication is from a large (6 qt capacity) reservoir which also serves steam end main bearing.

Other features of the Type H are fast-acting hand speed changing device, spark-proof emergency trip, convenient vertical hand valve position. The center line support and heavy shaft construction are said to provide unusually smooth operation and long service. Murray Iron Works Co.

3—MOTOR STARTER

Combination, across-the-line type, with fusible disconnect switch

The Class 11-204-N Starter consists of a disconnect switch, main line fuse clips and company's Life-Linestarter mounted in a common enclosure. The disconnect switch has visible blades and De-Ion arc quenchers. A self-indicating slamproof handle is provided in the cover. It has separate positions for on, off and open cover, and can be locked in the off position by up to three separate padlocks. Enclosures can be provided for general purpose, semi-dust-tight, dust-tight, other types. Starters are available for three-phrase operation, up to 600 v, 60 cycles. Westinghouse Electric Corp.

4—TROUBLE-SHOOTING INSTRUMENT TEAM

For checking on and recording of use of a-c and circuit reactions

This combination includes the TAG Recording Ammeter used portably with a Weston Clamp-Ammeter Model 633, Type AIR-A2R. Company says it can be used to cover all operations within a power, manufacturing or processing plant as an aid in preventing wasted power, time, labor and money — and the records obtained can reveal proper or improper handling of equipment, detect unwarranted use of power and discover unnecessary waste of production time by checking starting and ending time of operating equipment.

The clamp unit can be used for making rapid a-c measurement on either insulated or non-insulated conductors; it functions on the magnetic induction principle. The clamping jaw is hooked onto the conductor and current is induced in a winding on the magnetic circuit of the clamping jaw. By means of a rectifier network within the instrument, the induced a-c is rectified into d-c which is supplied to the recording ammeter. This clamping unit can be used with an extension cable. Tagliabue Instruments Div., Weston Electrical Instrument Corp.

6—GRID CONTROL TUBE

Mercury thyratron type; for extremely high d-c voltages, current

The MT-1530 is a cut-off or trigger tube designed to control high d-c voltages. Its peak anode voltage is 15,000 v forward or inverse. It can be built either as a negative or positive control tube. Among its applications is the testing of high voltage cable. The MT-1530 has a completely shielded cathode structure; it is constructed with the grid at the base of the upper half of the mercury-filled tube. Sheldon Electric Co.

7—BELT TRAINING CARRIER

Helps prevent belt damage and edge wear due to improper training

Described as particularly effective, this carrier needs to be installed only at intervals of 50 to 100 ft on many applications. The training rollers are designed to respond instantaneously to any shift of the belt off dead center and tilt the carrier into an angular position with respect to direction of belt travel. This returns belt to center and carrier resumes its normal position. Stephens-Adamson Mfg. Co.

8—HAND PRUNING SAW

Is lightweight, air-powered, with cutting capacity to 6 in.

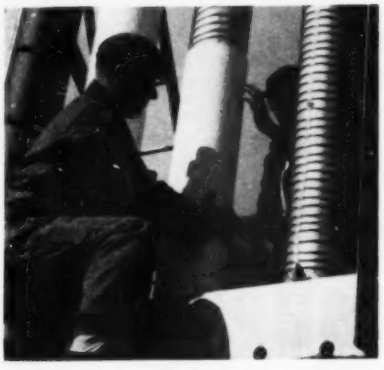
A recent addition of manufacturer's specialized pruning equipment for use by utility companies, maintenance crews etc. is this 5½-lb saw. Its standard length is 36 in., but several lengths are available depending on purpose required. It is easily handled, operates at 1500 strokes per min. Blades can be removed for sharpening when necessary. Any self-contained power air source or

5—ELECTRIC HEATING CABLE

Of heavy-gage nickel-chromium resistor wire, has many applications

Thermwire is an insulated, flexible, electric heating cable. It is used to protect roofs, gutter and downspouts from accumulations of snow and ice; when embedded in concrete, to melt ice from doorways, steps, walks and driveways; and to prevent pipes from freezing. It is suggested for use where a portable, pliable heat source is required to cope with cold weather.

Thermwire is packaged in sets, one 80 ft long, 400 w, 115 v; the other is 160 ft, 800 w, 230 v. Each has a 10 ft lead section and plug. Edwin L. Wiegand Co.



why CRANE 600-pound small steel gates are sure to meet your needs

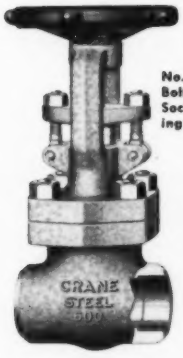
UNION BONNET GATE. Screwed ends. Sizes: ¼ to 2-inch. Available in three different trim materials for a wide range of services. Also with socket welding ends

You can't top these Crane Small Steel Gates for dependable performance on high pressure, high temperature lines . . . for ease of operation . . . for simplified maintenance. That's because they include design features normally found only in larger or more expensive valves.

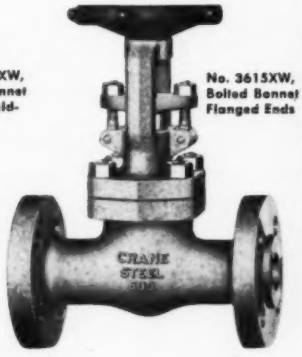
Then too, these Crane valves are available in a choice of types to meet your particular requirements. For example, with union or bolted bonnets; with screwed, flanged, or socket-welding ends; and in trim materials recommended for all common fluids.

GET NEW DESCRIPTIVE CIRCULAR AD-1881

For complete information—including prices—about these longer lasting, easier operating Crane Small Steel Gate Valves. Ask your Crane Representative for your copy, or write direct. No obligation.

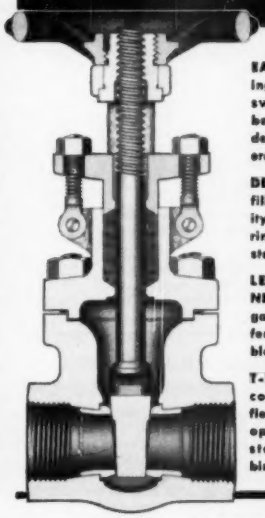


No. 3611XW, Bolted Bonnet Socket-Welding Ends



No. 3615XW, Bolted Bonnet Flanged Ends

Easy to Operate... Easy to Service



EASY ACCESS to stuffing box assured by swinging gland eyebolts. Improved yoke design provides liberal working space.

DEEP STUFFING BOX filled with high quality asbestos packing rings maintains tight stem seal.

LEAKPROOF BONNET JOINT. Soft iron gasket in male and female joint cannot blow out.

T-HEAD DISC-STEM connection provides flexibility for smooth operation; prevents stem distortion or binding of parts.

Cross-section No. 3607XW, Bolted Bonnet Gate, Screwed

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VALVES • FITTINGS • PIPE • PLUMBING • HEATING

power take-off compressor with capacities from 8 to 30 cfm can be used as a power source. Miller-Robinson Co.

9—SCREWDRIVER

For driving small screws in tight, hard-to-get-at places

A new screwholding screwdriver, the M8, has a long, thin plastic handle and is described as ideal for electrical work, other jobs involving small screws and close clearances. A slight push against the center slot fastens the screw to the blade tip, and this action rotates a steel locking pin in the center of the blade which locks the blade tip in the screw slot. This locking pin extends through the length of the blade to provide a positive grip that will keep the blade from slipping out of the slot. The blade tip can be ground fine or blunt, as required, and reground when it becomes dull. Chromoloy steel blade is 5 in. long, 3/16 in. wide and fits No. 3 to No. 7 screws. Shock resistant handle is 3 by 3/16 in. R. N. Hunter Tool Co.

10—VENTILATOR

Straight-through type, features simplified design, low height

The Whirlout Ventilator is "open" only when its propeller fan is operating, the air stream being utilized to open and

hold two semi-circular halves of the damper while forcing unwanted elements out of the building. A streamlined fan ring directly above the square-tipped blade propeller guides the airstream smoothly without back-flow. The new unit is supplied in a wide range of sizes, capacities. The Swartwout Co.

11—THERMOMETERS

Resistance type; for use with temperatures from —100 to 300 F

These new instruments, applicable to a wide variety of industrial processes, are available in three basic types: the HP-11, a resistance-thermometer indicator; the HP-13, a two-position controller or protector; and the HP-14, a three-position controller. Each type is designed for flush or surface mounting. All models use the same basic mechanism, a crossed-coil moving element and a high-strength 3¼-lb alnico V magnet. This mechanism is enclosed in a dust-tight moisture-resistant case-and-cover assembly to permit use in moist or contaminated atmospheres. Meter and Instrument Dept., General Electric Co.

13—SHUT-OFF VALVE

To protect gages in both pneumatic and hydraulic systems

This shut-off is designed to automatically cut out gages from the system when pressure goes beyond their operating limits — and to open the gages to the system when the pressure is again within operating range. The shut-off is available for both low and high pressure use. When installed in a hydraulic system with multiple gages, the shut-offs save valuable man hours spent on manual controls.

A compression spring controls pressure shut off point. Units are supplied with standard pipe thread connections, but can be furnished with AN adaptors. Connection to the system is made at the end of shut off, ½ in. pipe thread. Connection to gage is made on the side of shut off, ¼ in. pipe thread. Sprague Engineering & Sales Corp.

14—PACKLESS REGULATORS

To control temperature between 30 and 325 F in 60 deg ranges

The Type UBA Regulator is a packless, single seated, balanced and hermetically sealed instrument with dial adjustment at the top. It comes in ¼, ⅜ and ½ in sizes for steam pressures to 150 psig. Eight ft of capillary tubing and a 1 in. NPY connection on the bulb are standard. Farris Stacon Corp.

15—WELDING FITTINGS

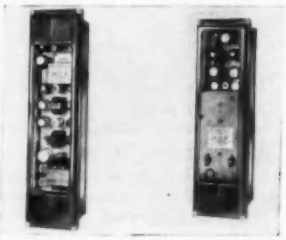
Of alloy steel, are extra thick to prolong life of piping system

The new Key-Kast line of welding pipe fittings and flanges is based on a new design of greater wall thickness throughout and added thickness at areas of stress. Manufacturer says this provides a stronger fitting and gives longer life to piping systems at a lower unit cost. Among advantages credited to the new fittings are greater structural strength and a larger allowance against corrosion and erosion. Company points out that the line meets ASA, ASME and ASTM standards and is available in low and intermediate alloys as well as various types of stainless steel. Key Co.

16—TELEMETERING EQUIPMENT

Transmitter and receiver; are designed for faster response

With the new millivolt-input Freq-O-Tron Telemetering Equipment, response of less than 0.3 sec exclusive of end devices is claimed possible. This equipment is intended to provide remote metering of any quantity that can be converted to a proportional millivolt quantity, and to transmit any value by use of either a microwave, power line carrier, or pilot wire medium. Flexibility of operation makes possible the totaliza-



tion of similar quantities at either the measuring stations, intermediate stations, or receiving stations.

The equipment consists of company's new Type IT-1 transmitter and IR-1 receiver, and is calibrated to user's requirements. It can be supplied as a complete installation including carrier or microwave communication systems. Westinghouse Electric Corp.

17—ELECTRONIC TIMER

Features continuously adjustable time interval, high accuracy

In the Model 701 Electronic Timer, the timing cycle is initiated by a contact closure and a single-pole, double-throw relay is operated at the end of the timed interval. Time intervals from 0.05 to 20 sec can be furnished. The relay contacts are rated at 115 v, 5 amp, non-inductive. Timer operates on 105 —130 v, 50–60 cycles. Company says the device recycles instantaneously, is unaffected by supply voltage fluctuations. Timetrol Co.

18—SEALED POTHEAD

Is lightweight, easily installed; protected against weather

This new terminal is fully sealed and weather-tight, says manufacturer, and affords complete safety during installation and servicing. Its weight of 15 lb permits one-man installation, and phases can be changed quickly without disturbing connections.

Sealing medium used around terminals is a silicone rubber elastomer that seals the voids, crotch and studs. It is removable when necessary, company points out, and its properties do not change between —70 F and 500 F.

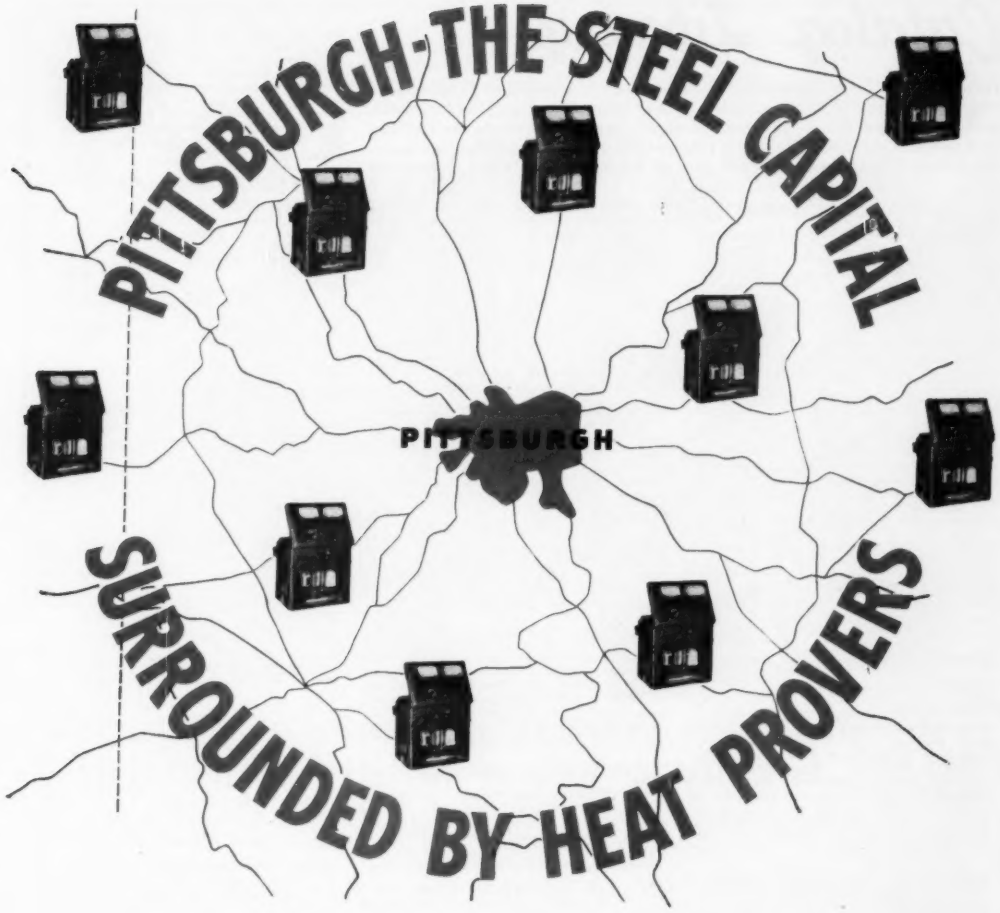
The pothead consists of a porcelain insulator ceramic body with three brass studs mounted at an angle in projecting ceramic sleeves. A removable ceramic separator isolates each stud and makes a pocket around the stud for holding the filler in place. DeVelco Inc.

12—COLLAPSIBLE AIR DIFFUSER

For diffusing gases into liquids to effect absorption, agitation

The Colaflex Diffuser is a flexible, collapsible unit designed to maintain practically constant permeability for fine diffusion of air or gas in sewage and industrial waste treatment, water conditioning, absorption processes. Announced as an important feature is the ease with which it can be cleaned and its permeability maintained.

The diffusing element is fabric. Gas or air under pressure inflates the element to an erect, distended position and diffuses through the fabric to the liquid. To clean the fabric you shut off the gas or air supply by means of a three-way valve provided. The air is suddenly vented to atmosphere and the fabric collapsed by the pressure of the liquid and inverted downward into its cup. This flexing of the walls dislodges or loosens solid particles that may have accumulated in the cloth. The fabric used in the diffuser is said to be extremely durable. Infilco Inc.



When your eye is on Pittsburgh—and three dozen towns in its orbit—you're spotting scores of furnace operations regularly checked by Cities Service Heat Provers. Here, where they know all kinds of furnace instruments, and where high efficiency is most urgent today, the application of Heat Provers by Cities Service is increasingly valued.

It takes the Heat Prover to read simultaneously for oxygen and combustibles, measured direct by actual gas analysis. And the Heat Prover's continuous rapid sampling reveals effects of furnace adjustments at once. The Heat Prover frees you of maintenance too, because it's *not an instrument you buy, but a Service we supply.* Learn how it can raise productivity for you . . . in iron, steel, ceramics, glass, cement or any other furnace operation. Write CITIES SERVICE OIL COMPANY, Dept. A23, Sixty Wall Tower, New York City 5.

CITIES SERVICE

QUALITY PETROLEUM PRODUCTS

Catalog Library

THIS MONTHLY list of standard catalogs and bulletins is published to help power engineers maintain a permanent catalog file of engineering data. The items listed, unlike those under Helpful Bulletins, will appear each month except for additions and deletions determined by space requirements or by the manufacturers issuing the bulletins. Use the postage-paid card on pages 37 and 38 for your request

WATER CONDITIONING

201 Water Conditioning Information — Here are three informational bulletins. No. 28X7446 describes a simple way to determine total hardness in water, illustrating procedure. No. 28X7559 gives an analysis of the hot process-hot zeolite system, telling results to be expected. No. 28X7466 discusses current status of embrittlement in boilers, explaining causes and telling recent developments in control methods. List bulletins wanted. Allis-Chalmers Mfg. Co.

202 Modern pH and Chlorine Control — This 100-pp booklet gives details of company's color comparators and equipment in water testing and control of boiler and industrial process water, also technical information on meaning of pH control, electrometric and colorimetric methods of determining pH and impurities in water; applications of water control in air conditioning; treating boiler feed water. W. A. Taylor & Co.

203 Water Softening Equipment — How problems caused by hard water can be offset by water softeners is explained in Bulletin 2386, 12 pp, describing ion exchange equipment. It covers in detail downflow, upflow and gravity zeolite water softeners. The Permutit Co.

204 Treating Sulfide Contaminated Water — A practical and low-cost method of removing malodorous sulfides from water supplies by means of company's Amberlite IRA-410 which, when operated in the chloride cycle, will effectively remove and replace sulfides with chloride ions is presented in 5-pp Form 20R. It discusses operating procedure, properties of this amine-type anion-exchanger, regeneration, simultaneous softening and sulfide removal. Includes graphs showing effect of influent composition on sulfide capacity and sulfide capacities at pH 7.0. Resinous Products Div., Rohm & Haas Co.

205 Water Conditioning Bulletin — This is an 8-pp discussion of water and the chemicals developed for conditioning it to control scale and algae and inhibit corrosion. Describes several chemicals in detail, giving properties, composition and application. Wright Chemical Corp.

206 Water Treatment — Bulletin 5000, 24 pp, explains the reasons for boiler water treatment and tells services offered by company in providing formulations for individual plant requirements. Covers pre-treatment, internal treatment, treatment application, blowdown adjustment, test control. Describes available equipment and includes reference bibliography of literature on specific formulations. Dearborn Chemical Co.

207 Boiler Corrosion — A 12-pp article discussing cause and prevention of corrosion in boiler systems is presented in Beta Technical Paper No. 111. The corrosive effects of oxygen, carbon dioxide, ammonia, hydrogen sulfide, acidity, physical factors are evaluated. W. H. & L. D. Beta.

208 Chemical Treatment of Water — Bulletins describing various methods of chemical water treatment, including company's Coravol process, are available. Coravol is part of a complete technical service which provides special chemical formulas for boiler feed water, foam prevention, hot water supply, refrigerating brine, cooling and condenser water. Western Chemical Co.

209 Zeolite Water Softeners — Publication 4530, 16 pp, presents hydrogen zeolite (cation exchange) water softening equipment. Gives complete description of the process and the field of application, showing advantage of hydrogen zeolite softening and its relation to sodium zeolite softening process. Cochrane Corp.

210 Slurry Type Softener — Six-pp Bulletin W-212-B6 describes a slurry type precipitating softener and coagulator in which energy for floc preparation is mechanical, explaining and illustrating flow circuit. Question-and-answer appraisal of system. Worthington Pump and Machinery Corp.

211 What's New on Ion Exchangers — Here are three booklets covering company's ion exchangers: Nalcite HCR, a styrene type cation exchanger; Nalcite SAR, a strongly basic anion exchanger; and Super Nalcolite, a synthetic gel type zeolite for cation exchange. Tables and graphs explain performance of these water treating resins under various operating conditions. Physical characteristics, exchange capacities, regeneration techniques discussed. Bulletin 57, 20 pp, is on Nalcite SAR; Bulletin 58, 28 pp, Nalcite HCR; Bulletin 59, 8 pp, Super Nalcolite. State those wanted. National Aluminate Corp.

212 Water Softeners — Bulletin WC-102 is a 36-pp presentation of recent developments in hot-process water softeners. Explains boiler plant troubles caused by various impurities in water, outlines 12 methods of treating water, describes reasons for the popularity of the hot-process method, explains chemistry of hot-process water softening. Graver Water Conditioning Co.

FUEL OILS, LUBRICANTS

214 Fuel Oil Treatment — By text and sketches, this folder points out undesirable conditions in the storing, pumping, heating and burning of industrial fuel oil and correction of these conditions by company's treatment. E. F. Drew & Co., Inc.

215 Air Compressor Lubrication Manual — Valuable information on air compressor maintenance is contained in this 40-pp book. Subjects treated include compressed air, compressors and related equipment, lubricating systems, compressor oils and applications, lubrication requirements, operating hints, oil requirements, storage and care of compressor oils, safety precautions. Cities Service Oil Co.

216 Diesels, Their Fuels and Lubricants — This 46-pp book gives practical information on diesel engines, covering their history and economics as well as design characteristics and operating principles. Classification of diesels according to speed is explained. Other chapters cover injection systems, combustion chambers, also lubricating systems, and diesel oil purification and filtration. Includes discussion of fuel and lubricating. Sinclair Refining Co.

217 Viscosity of Fluids — The larger significance of viscosity is discussed in Nos. 5 and 6, Vol. 36 of Lubrication, a technical publication. In six parts, the first illustrates simplest conception of streamline flow between two surfaces having relative motion. A series of torsion viscometers shows how viscosity acts and may be measured. Part II covers streamline flow in capillary and other small tubes. Part III covers turbulent flow in pipes. Part IV discusses effects of temperature and pressure on viscosity, and Part V includes viscosity index. Part VI gives brief reference to nature of plastic flow. The Texas Co.

218 Clean Oil for Diesels — A combination purifying and filtering unit utilizing centrifugal force and controlled filtration is the subject of illustrated Bulletin DL-1. Explains operation of the unit, tells advantages. Discusses importance of clean, dry lubricants, shows a schematic arrangement of piping for use of the Puri-Filter in removing dirt, carbon and water from lubricating oil. Also discusses purification of fuel oil for diesel engines. The DeLaval Separator Co.

VALVES, TRAPS, PIPING

270 Popular Steel Valves — Condensed Catalog 104, 28 pp, describes and illustrates most widely used of company's cast and forged steel valves and the data presented for these valves is complete. Those listed are chiefly in the basic steam pressure classes — 150 to 2500 lb — and include globe and angle, gage, instrument, hydraulic and relief types, also strainers, and check, gate, non-return and blow-off valves. Explains design features. Edward Valves, Inc.

221 Valves, Fittings and Flanges — Catalog F-9 is a 400-pp, permanently bound reference book on drop forged steel valves, fittings and flanges for practically all piping needs at high and low pressures and temperatures. Provides ordering information on company's complete line, also much helpful engineering and application data; includes a section on products for refrigeration service. Fully illustrated, indexed. Available to qualified power engineers, please give your title. Henry Vogt Machine Co.

222 High Pressure Gate Valve — Described in 4-pp Form DH-273 is a forged steel gate valve designed for long service and low cost maintenance. Working pressures, sizes and prices listed. R-P & C Valve Div., American Chain & Cable Co., Inc.

223 To Get at Those Valves — This little folder describes a sprocket rim with chain guide. The rim adjusts to fit all valve wheels. Babbitt Steam Specialty Co.

224 Steam, Air and Gasoline Traps — Illustrated Catalog 751, 32 pp, provides capacity tables, installation diagrams and a section containing data, charts and formulas for determining proper size trap for specific applications. Covers thermostatic steam traps for pressures to 225 lb; expansion steam traps for pressures to 250 lb; weight-operated traps for steam, air, gasoline, pressures to 1500 lb; piston-operated steam traps for pressures to 650 lb. W. H. Nicholson & Co.

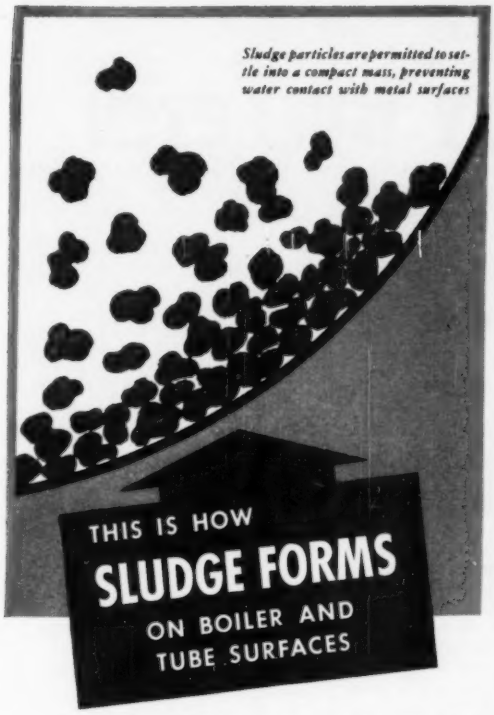
225 Valve Specialties — Included in 90-pp Catalog A-50 is complete ordering and engineering information on automatic pressure flow and liquid level controls for steam, air, gas, water, oil, other fluids. Sections are devoted to pressure regulators, altitude valve, pump governors and strainers; lever, float and motor operated valves, pilot valves; back pressure, relief and non-return valves, steam trap and air vent; liquid level controllers; solenoid valves. Includes capacity charts. Davis Regulator Co.

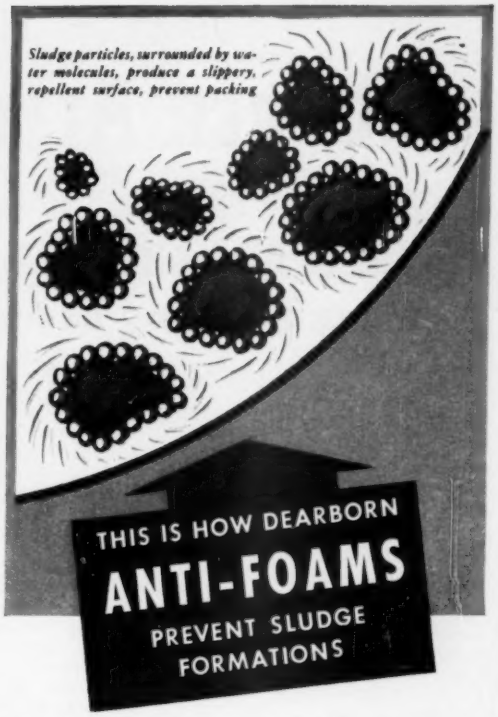
226 General Service Valves — Bulletin E-160, 16 pp, describes and illustrates design and construction of company's quick-operating valves, explaining their application to blow-off service and on chemical process, soot blowers, water column blow-down, and other types of pipe line. Includes dimensions, weights; prices. Everlasting Valve Co.

227 Forged Steel Valves — Form 800-A describes 600-lb forged steel valves for high line pressure and temperature applications. Covers both inside screw and OS&Y union bonnet gate types, giving sizes, prices. The Ohio Injector Co.

228 Trap Data — Here's a 12-pp condensed catalog giving information and prices on steam and air traps. Lists cast semi-steel and forged steel inverted bucket traps, compound steam traps, ball float air traps, Y-type strainers and internal check valves. Provides data on calculation of condensate loads and a selection of traps to handle these loads, also a full-page capacity chart. Armstrong Machine Works.

(Continued on page 128)


Sludge particles are permitted to settle into a compact mass, preventing water contact with metal surfaces
THIS IS HOW
SLUDGE FORMS
ON BOILER AND
TUBE SURFACES


Sludge particles, surrounded by water molecules, produce a slippery, repellent surface, prevent packing
THIS IS HOW DEARBORN
ANTI-FOAMS
PREVENT SLUDGE
FORMATIONS

DEARBORN POLYAMIDE ANTI-FOAMS KEEP SOLIDS IN SUSPENSION—PREVENT SLUDGE FORMATIONS

Dearborn Polyamide Anti-Foam No. 659 performs four important functions in boiler water treatment.

1. It makes it easier to maintain a fluid type sludge in boiler water. It prevents growth of the sludge crystals and does not permit them to become attached to the heating surfaces.
2. Anti-Foam No. 659 has protective colloid action which controls the precipitation of carbonate scale. It also prevents "after precipitation" where lime soda water is used for make-up.
3. As an Anti-Foam treatment, No. 659 reduces the number of small bubbles responsible for foaming conditions. Instead, it produces a relatively small number of large bubbles which break harmlessly on the surface.
4. Anti-Foam No. 659 prevents corrosion in feed lines, heaters and internal boiler surfaces caused by dissolved oxygen.

Consult your Dearborn representative for assistance in selecting the boiler water treatment best suited to your needs.

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Merchandise Mart Plaza • Chicago 54, Ill.

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For information on Dearborn Polyamide Anti-Foams, write for Bulletin No. 5008.

For a complete description of Dearborn Industrial Water Treatment and Engineering Service, write for Bulletin No. 5000. The coupon is for your convenience.

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Studies of Biofouling in Sea Water Aid in Selecting Condenser Tube Alloys

The extensive tests conducted by the Bridgeport Brass Research Laboratory have revealed much useful information on the nature and extent of biofouling of copper-base alloys in sea water.

In a typical test at Kure Beach, specimens of various copper and copper-base alloys were arranged at random in a specially-designed rack. They were suspended about 15 inches below the surface of a stream of sea water flowing between 2 and 3 feet per second. Samples were under test from 6 months to 7 years.

Extent of Biofouling Measured

Early in the tests it was noted that some alloys were badly biofouled by relatively large marine flora and fauna, while others were practically unaffected. The extent of biofouling in terms of per cent of surface covered by marine organisms is given in Figures 1 and 2, which also give the total rate of corrosion and the calculated loss of copper for each of the condenser tube alloys tested.

Biofouling Leads to Pitting

It is interesting to note that wet, living biofouling can be quite easily removed from most specimens by scrubbing with a stiff fiber brush and water. Such scrubbing leaves only a thin layer of corrosion product on the specimen. However, if the biofouling is allowed to die and dry for one to two weeks, considerable difficulty is experienced in removing those organisms with calcareous bases such as barnacles. The cone of the dead barnacle is usually sheared off, leaving the more or less circular base adhering to the metal. Barnacles whose shells had turned green produced small pits approximately 0.0005 in. up to 0.007 in. deep. No pits were detected when the specimens were removed from the water while the barnacles were still alive (not green).

From a practical standpoint, it is important to prevent biofouling from taking place on metal surfaces. This can be done by operating the water velocity high enough to prevent organisms from attaching themselves to the tube wall and by periodic chlorination.

All of the specimens were covered with a slime which was microscopically identified as being primarily microalgae which were living on these corroding metal surfaces. No evidence was found, however, to indicate that the algae (macro or micro) contribute to accelerated corrosion in stress-free specimens submerged in sea water.

Effect of Alloying Elements

The addition of 5% aluminum to copper did not appreciably change the rate of corrosion, but the presence of aluminum did for some reason or other make the aluminum bronze quite susceptible to biofouling. The addition of arsenic to the 5% aluminum bronze reduced the corrosion rate approximately 50% and increased the susceptibility to biofouling. The addition of 2% aluminum and 0.02% arsenic to a 75/25 copper-zinc alloy (aluminum brass) reduced the corrosion rate approximately 70% and very markedly increased the susceptibility to biofouling. The addition of 0.42% iron to 70/30 cupro nickel reduced the corrosion rate about 80% and simultaneously increased the susceptibility to biofouling.

Such tests combined with experience in the field regarding the behavior of alloys in actual service are useful in helping to select alloys for longer service life.

It should be noted that the alloys showing increased resistance to corrosion are more susceptible to biofouling. Consequently, in order to realize the benefits from increased resistance to corrosion, such alloys must be kept free from biofouling. (7659)

Fig. 1—Extent of biofouling versus rate of corrosion of condenser tube alloys in sea water

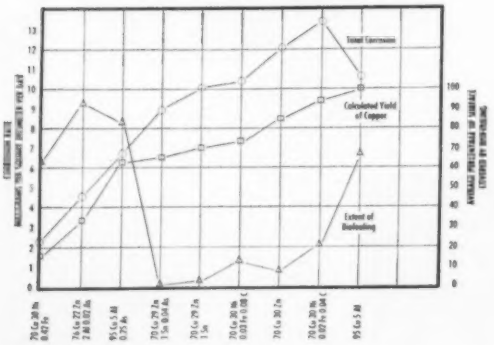
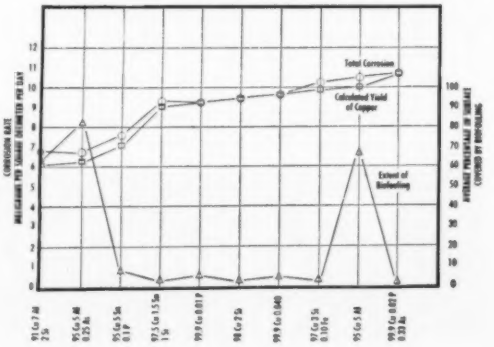
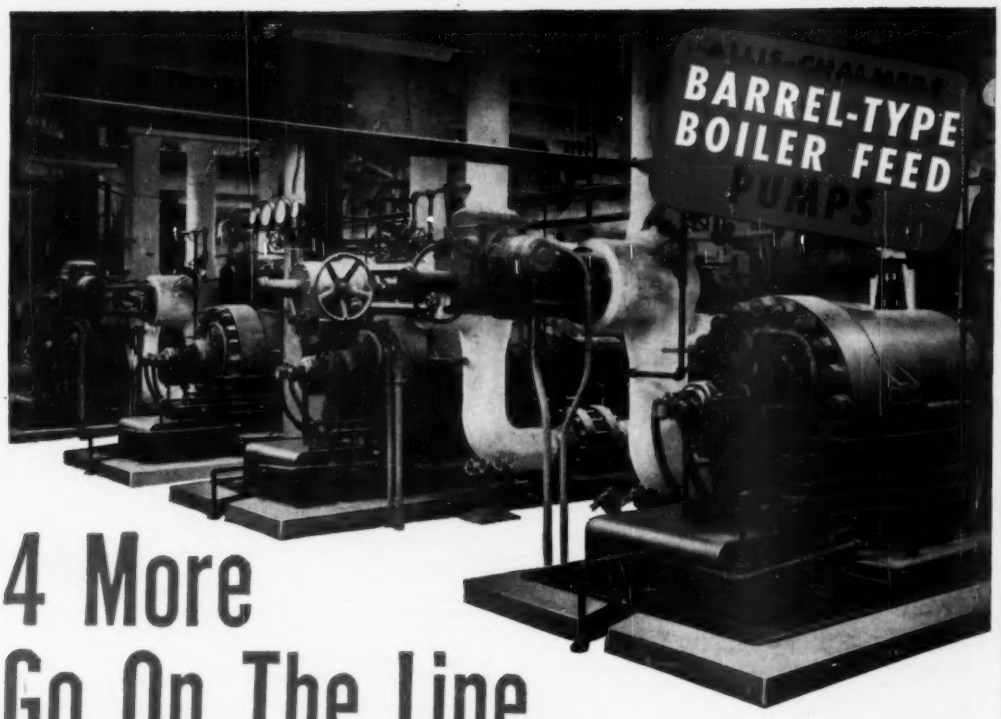


Fig. 2—Extent of biofouling versus rate of corrosion of copper and bronzes in sea water





4 More Go On The Line

AT NEW HAWTHORN STATION, KANSAS CITY

Over 50 of these pumps have been bought by utilities on their proved performance record.

NEWEST PLANT OF KANSAS CITY POWER & LIGHT CO. is the Hawthorn Steam Electric Station on the Missouri River. This station, designed with every modern feature for dependability and low cost operation, has an initial capacity of 132,000 kw from two turbines and is already building an addition that will add almost another 100,000 kw from one additional turbine.

The boiler feed pump arrangement, pictured above, consists of four Allis-Chalmers 8" x 8" barrel-type boiler feed pumps with a capacity of 700,000 pounds per hour each at a discharge pressure of 1625 psig. They are driven by 1750 hp, 3600 rpm motors.

The unit now under construction also will be served by Allis-Chalmers barrel-type boiler feed pumps. Three pumps with a capacity of 425,000 pounds per hour at 1815 psig driven by 1250 hp, 3600 rpm motors are now being built.

Engineering Features

Unique engineering features designed to increase reliability and reduce maintenance have been proved in operation. Single-stage, back-to-back impellers balance axial forces without the use of a balancing drum. First stage has twin, half capacity impellers to give the advantages of low NPSH. Expansion joint is brought to the outside of the pump where leakage may be quickly detected and adjustments made without dismantling the pump. No flexible internal members are required to compensate for expansion.

Sizes range from 1200 to 3000 psig and from 300 to 2500 gpm. Allis-Chalmers can supply the complete boiler feed pump installation including pump, motor and control of coordinated design and manufacture.

Get the details on this modern-design, performance-proved boiler feed pump from your Allis-Chalmers District Office, or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3522

ALLIS-CHALMERS A-C ALLIS-CHALMERS

POWER PLANT *Construction News*

Folsom, Calif. — Bureau of Reclamation, Denver Federal Center, Denver, Colo., has plans maturing for new hydroelectric generating plant near Folsom, with installation of hydraulic turbines and auxiliary equipment with rated capacity of 160,000-kw. Plant will be 120 x 240 ft, and 107 ft high. Bids are expected to be asked in near future.

Los Angeles, Calif. — Borden Co., Chemical Division, 350 Madison Ave., New York, N. Y., industrial resins, adhesives, etc., plans boiler plant at new branch plant at Dominguez, near Los Angeles, where tract of 8 acres land has been selected. It will comprise a main one-story building, equipped for production of resorcin, used in manufacture of adhesives, hard resins, etc., totaling about 100,000 sq ft floor space. Cost estimated over $600,000. Work is scheduled to begin soon.

Los Angeles, Calif. — United Rubber Corp., 821 Traction Ave., Los Angeles, plans boiler plant at proposed new mill on 16-acre tract of land at Arlington Ave. and Dominguez St., to comprise several buildings for processing and production of latex. Cost reported close to $2,000,000.

Foley, Fla. — Buckeye Cellulose Corp., care of Procter & Gamble Co., Gwynne Bldg., Cincinnati, Ohio, recently formed as a subsidiary interest, plans power house at proposed new cellulose pulp mill near Foley (Taylor County). It will consist of several units, equipped for large output. Cost reported in excess of $2,500,000. It is understood that work will proceed in 1952.

Atlanta, Ga. — Board of Regents, University System of Georgia, 20 Ivy St., S.E., Atlanta, plans expansion on boiler plant at local Georgia School of Technology, including installation of new boiler units and auxiliary equipment. No official estimate of cost announced. Robert & Co., Associates, 96 Poplar St., N.W., Atlanta, are architects and engineers.

Rome, Ga. — Georgia Power Co., Atlanta, has awarded contract to Virginia Bridge Co., Atlanta, for structural steel framing for proposed new steam-electric generating plant at Rome, previously mentioned in these columns, and work will begin soon. It will have a capacity of 200,000-kw, and is estimated to cost approximately $20,000,000. Site has been acquired on Coosa River.

Chicago, Ill. — Campbell Soup Co., 2550 West 35th St., has plans for addition to power house at local factory. Cost reported close to $500,000, with equipment. Battey & Childs, 231 South LaSalle St., Chicago, are engineers.

Chicago, Ill. — Templeton-Kenly Division, American Brake Shoe Co., 109 North Wabash Ave., plans boiler house at proposed new plant at Broadview, near Chicago, consisting of a main one-story building, totaling 80,000 sq ft floor space. Entire project is reported to cost in excess of $500,000.

Willow Springs, Ill. — Buick Motor Division, General Motors Corp., Flint, Mich., plans power house at new plant for manufacture of jet aircraft engines in Lyons Township, near Willow Springs. It will comprise several buildings, totaling 1,450,000 sq ft floor area. A pumping station will be built, and 400,000-gal elevated water tank. Entire project will cost about $36,000,000. Argonaut Realty Co., Division of General Motors Corp., Research Bldg., Detroit, Mich., is architect and engineer.

Hammond, Ind. — Northern Indiana Public Service Co., Hammond, is arranging an expansion and improvement program in 1952–53 to cost in excess of $35,000,000, including extensions in generating facilities, power substations, transmission and distributing lines.

Terre Haute, Ind. — Public Service Co. of Indiana, Indianapolis, Ind., is completing plans for steel frame superstructure for proposed new steam-electric generating station near Terre Haute, previously noted in these columns, and will begin work soon. Cost reported close to $25,000,000, with turbine generators, high-pressure boilers and auxiliary equipment. Sargent & Lundy, 140 South Dearborn St., Chicago, Ill., are consulting engineers.

Lawrence, Kan. — Consumers Cooperative Association, 318 East 10th St., Kansas City, Mo., plans boiler plant at proposed new commercial fertilizer works, near Lawrence. Site has been acquired. It will comprise a number of units and is reported to cost about $16,000,000, complete. Work scheduled to be carried out in 1952. A subsidiary interest, Cooperative Farm Chemicals Association, has been organized to operate plant.

Baltimore, Md. — Consolidated Gas, Electric Light & Power Co., Lexington Bldg., has plans for new steam-electric generating station at Turners Point, reported to cost over $2,500,000, and will carry out work soon.

Chelsea, Mass. — Commonwealth of Massachusetts, Soldiers' Home, John L. Quigley, commandant, 91 Crest Ave., Chelsea, has plans for extensions and improvements in boiler plant at institution, including installation of new boiler unit and auxiliary equipment. Office of Hollis French, 210 South St., Boston, Mass., is engineer.

Detroit, Mich. — Chrysler Corp., 341 Massachusetts Ave., will build boiler plant at new works on 36-acre tract of land on Van Dyke Rd., near 16-Mile Rd., McComb County, for production of jet aircraft engines for U. S. Navy Department. Plant will comprise a group of large buildings and is reported to cost approximately $30,000,000. Work will be placed under way soon.

Cleveland, Miss. — Mississippi Power & Light Co., Lampton Bldg., Jackson, Miss., will have plans prepared by Ebasco Service, Inc., 2 Rector St., New York, N. Y., consulting engineer, for proposed new steam-electric generating plant near Cleveland, recently noted in these columns. Installation will include two turbine-generator units, each with capacity of 105,000-kw, high-pressure boilers and auxiliary equipment. Entire project reported to cost close to $20,000,000

Yazoo City, Miss. — Public Service Commission plans extensions and improvements in municipal electric generating station, with installation of equipment for increased capacity. Entire project is estimated to cost about $1,700,000, including improvements in distribution system. Bond issue is being arranged in amount noted.

Gallup, N. M. — Town Council has authorized surveys and estimates of cost for extensions and improvements in municipal steam-electric power plant, with installation of equipment for increased capacity. Rocky Mountain Engineering Co., Wilda Bldg., Denver, Colo., is consulting engineer.

Newburgh, N. Y. — Central Hudson Gas & Electric Corp., Poughkeepsie, N. Y., has plans under way for addition to Danskammer Point steam-electric power plant, near Newburgh, with installation of new 60,000-kw turbine-generator, high-pressure boiler and auxiliary equipment. Cost reported over $10,000,000. Burns & Roe, 233 Broadway, New York, N. Y., are consulting engineers.

Franklin, N. C. — Nantahala Power & Light Co., Franklin, plans new hydroelectric generating plant on Tuckasegee River in Jackson County, N. C., where site has been selected. It will be equipped for an initial capacity of 100,000-kw. Cost estimated about $2,700,000. It is understood that work will be carried out in 1952.

Youngstown, Ohio — United States Steel Corp., 71 Broadway, New York, N. Y., plans new steam-electric power plant at works at Youngstown. Installation will include turbine-generators, high-pressure boilers and auxiliary equipment. Completion is scheduled in 1953. Cost reported in excess of $9,000,000.

Morrisville, Pa. — United States Steel Corp., 71 Broadway, New York, N. Y., will have plans prepared by H. K. Ferguson Co., 19 Rector St., New York, and 1783 East 11th St., Cleveland, Ohio, engineer and contractor, for new steam-generating station at Fairless Steel Works, Morrisville, now in course of construction. It will be used for central-heating service and will represent large investment — no official estimate of cost announced.

Pickens, S. C. — Blue Ridge Electric Corp., Pickens, has preliminary plans under way for new hydroelectric power plant on South Fork of New River, in Ashe County, N. C., where site has been secured. Entire project is reported to cost about $15,000,000, with power dam, hydraulic turbines, electric generators and auxiliary equipment. L. A. Schmidt, Jr., 817 Broad St. Chattanooga, Tenn., is consulting engineer.

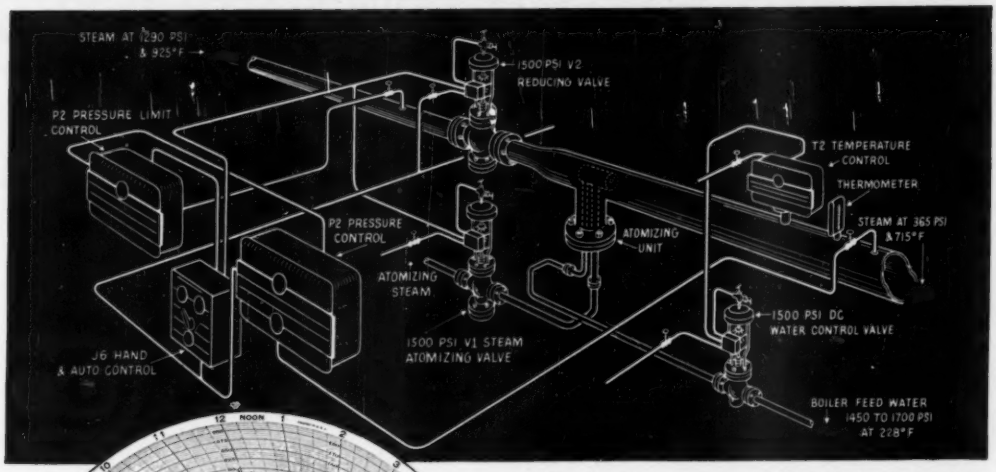
Elizabethton, Tenn. — Monadnock Paper Mills, Inc., Bennington, N. H., plans power house at proposed new pulp and paper mills at Elizabethton. Plant will consist of a number of large buildings. It will be constructed by municipality and occupied by company under long-term lease. Cost reported close to $20,000,000. Plans will be prepared soon. H. K. Ferguson Co., 1783 East 11th St., Cleveland, Ohio, is engineer and will supervise construction.

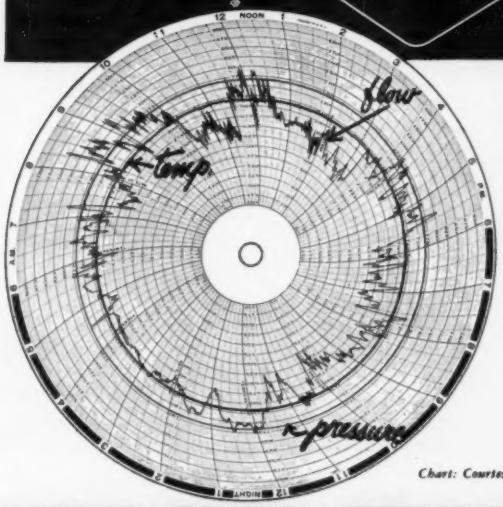
Beaumont, Tex. — Gulf States Utilities Co., Beaumont, has arranged an expansion and improvement program in 1952 and 1953, to cost about $56,500,000, of which approximately $30,000,000 will be expanded in first 12 mos. Work will include expansion in Neches power station, with installation of new 60,000-kw turbine-generator, and extensions in Louisiana plant at Baton Rouge, where a new 100,000-kw turbine-generator unit will be installed by 1953, and an additional 40,000-kw generator and accessories, scheduled to be ready for service in 1954.

Danville, Va. — Dan River Mills, Inc., Danville, plans addition to power house at cotton mills, with installation of additional boilers and auxiliary equipment. Cost reported about $2,750,000. Work will be carried out in 1952.

CORRECTION NOTE: — In the November issue, Power Plant Construction News, page 52, one item announced plans for construction of a new factory and power house at Versailles, Ky., by Standard Products Co. of Cleveland, Ohio. After the issue was off the press, we were informed that this project has been postponed indefinitely.

Swartwout RDC* controls within ±1 psi and ±3°F even with widely fluctuating load swings


STEAM AT 1290 PSI & 925°F
1500 PSI V2 REDUCING VALVE
P2 PRESSURE LIMIT CONTROL
T2 TEMPERATURE CONTROL
THERMOMETER
P2 PRESSURE CONTROL
ATOMIZING UNIT
STEAM AT 365 PSI & 715°F
ATOMIZING STEAM
1500 PSI DC WATER CONTROL VALVE
J6 HAND & AUTO CONTROL
1500 PSI V1 STEAM ATOMIZING VALVE
BOILER FEED WATER 1450 TO 1700 PSI AT 228°F

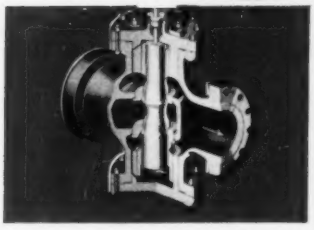


1 Chart shows how Swartwout RDC*—Reducing, Desuperheating and Control System—handles low-pressure turbine load of 65,000 to 165,000 lbs. steam per hour in Des Moines Power Station No. 2 of the Iowa Power and Light Company. It reduces from 1290 to 365 psi and desuperheats from 925° to 715°F. When main reducing valve closes, extremely light loads can be handled by pressure reducing valve supplying atomizing steam. Operation of the system is stable regardless of load change or time lag. Because of the exceptional control obtained by this large station, the Iowa Power and Light Company later purchased an additional small Swartwout RDC unit to supply steam to house turbines.

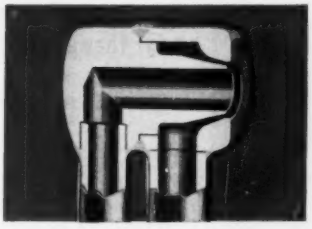
Swartwout

POWER PLANT EQUIPMENT

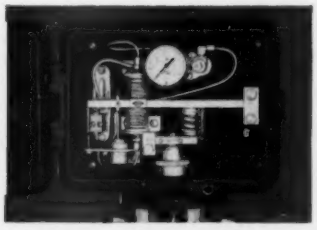
Chart: Courtesy Iowa Power and Light Company



2 Swartwout V-2 Regulating Valve has smooth, nozzle-shaped passages which guide expansion of high-pressure steam to reduced pressure zone without high-velocity impingement or other destructive forces common to conventional valves. Undue noise, turbulence and vibration are eliminated; longer valve life results.



3 Swartwout Steam Atomizing Desuperheater, constructed of stainless steel, has accurately machined passages that give narrow-angle dispersion of cooling water outside of steam atomizing head. There is no impingement of steam or water against walls of unit, no erosion of parts, no need for pipe liners.



4 Swartwout T-2 Control, with metallic temperature element in steam pipe, gives rapid and precise control regardless of magnitude of load or time lag. There are no flapper valves, relays or other delicate elements. Only two simple adjustments are involved; one for temperature, one for response

A-5092

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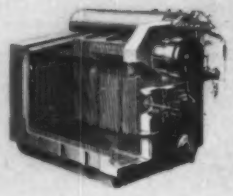
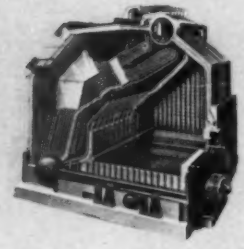
—now

...B&W INTEGRAL-FURNACE

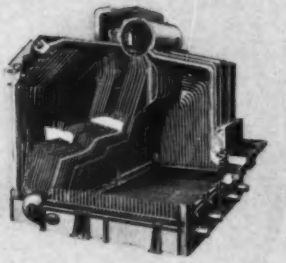
for steam requirements from 2800 to 350,000 lb. per hr.



TYPE FM
(Factory-assembled Unit)



TYPE FF



TYPE FJ

cost-saving features

- Minimum floor space and headroom requirements
- High fuel economy
- Smokeless combustion
- Adaptable to all fuels and firing methods
- Economical fast steaming
- Water-cooled furnace
- Clean, dry steam at all ratings even with high boiler water concentrations
- Quick response to wide and heavy load swing demands
- Easy to inspect and clean
- High availability with least attention

over 167 million lb. of steam per hr. for these industrial, utility, and other users

Abrasives
Airlines
Automotive
Baking
Beverages
Brewing
Building Materials
Candy
Chemicals
Dairy
Distilling
Drugs
Electrical
Electronics
Food
Foundry
Fruit Packing
Glass
Iron & Steel
Laundry
Leather
Lumber
Machinery
Meat Packing
Metal Working
Mining
Non-Ferrous Metals
Oil Refining
Paint
Paper
Plastics
Process
Rubber
Sugar
Textile
Tobacco

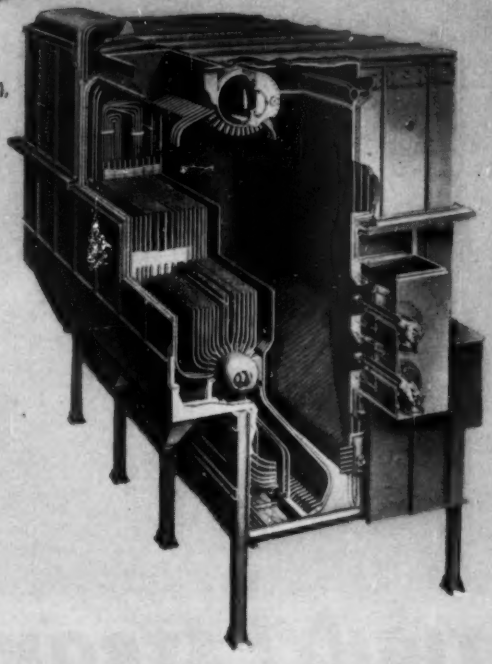
Utilities
Gas Companies
Municipal Plants
Power Plants
Railroads

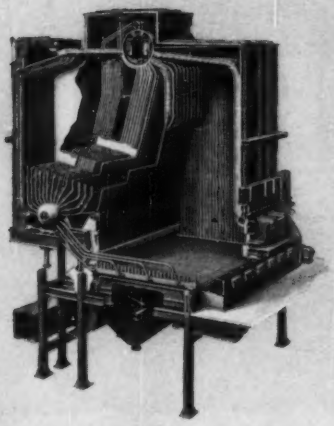
Others
Colleges
Florists
Hospitals
Hotels
Housing Projects
Institutions
Military Posts
Navy Yards
Office Buildings
Ordnance Plants
Stores

BOILER ADVANTAGES

Examples of B&W Engineering For Economy

TYPE FH
with hopper bottom (as shown), or flat floor





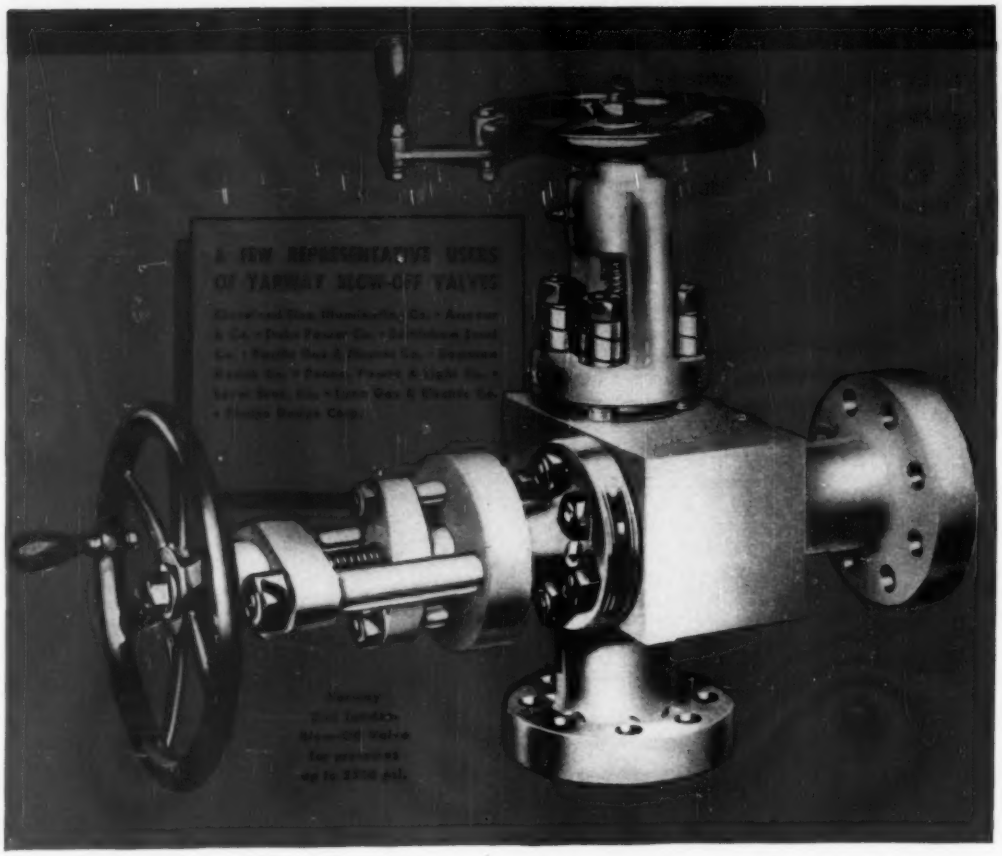
TYPE FL

the B&W integral-furnace BOILER family

TYPE	CAPACITY RANGE LB. STEAM/HR.	PRESSURE PSI	TEMPERATURE	FIRING
FM	2,800- 25,000	15- 275	Saturated	Oil and Gas
FF	8,000- 50,000	160- 600	Superheat	Stoker, Oil, and Gas
FJ	30,000- 70,000	160- 800	Superheat	Stoker, Oil, and Gas
FL	60,000-120,000	160-1050	Superheat	Stoker, Oil, and Gas
FH	50,000-350,000	160-1050	To 910F	Pulverized, Coal, Oil, and Gas

BABCOCK & WILCOX

O-5227



TIGHT! STRONG! for even toughest blow-down requirements

The Yarway Unit Tandem Blow-Off Valve meets the most demanding requirements for boiler blow-down or drain service.

It's drop-tight—and rugged enough to withstand the severe punishment of regular or emergency blow-down under pressure, or periodic acid wash.

Two Yarway Stellite-Seat Hard-Seat Valves or a Hard-Seat (blowing) and Seatless (sealing) Valve are combined in a one-piece forged-steel body. Designed for pressures up to 2500 psi.

It is significant that more than 4 out of 5 high pressure boiler plants use Yarway Blow-Off Valves.

For more facts, see Yarway Bulletin B-432.

YARNALL-WARING COMPANY
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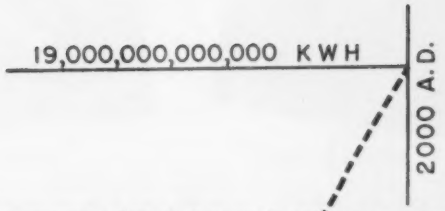
YARWAY **BLOW-OFF VALVES**

MORE POWER and Still More POWER



1952 ANNUAL FORECAST

THE DOTTED red curve running through these words represents an excursion into the future—into the not-too-far-distant future, for the year 2000 is less than 50 years away and some of the younger generation who read this may live to see whether what is said here comes true. This curve represents the future growth of power consumption in the United States. It indicates that by the year 2000 the consumption of energy in this country will equal the consumption of the entire world today, something around nineteen trillion kilowatthours annually.

Much as we Americans believe in an expanding economy, figures such as these make us wonder; just where is all the material, equipment, and technical know-how to come from? Even now, our copper supply is undergoing severe strains, and certain other materials are even scarcer. Fuel sources, at present, give us no worries but within the coming century the fuel situation as we now know it will not exist and our problems with respect to fuel will be much more difficult to cope with than they are now. The amount of material in equipment will be vastly greater than it is now; we will need more copper, more steel, more aluminum, more concrete, lumber, chemicals, etc. If the present trend continues—if the figure of 19 trillion kilowatthours is even reasonably correct—our installed generating capacity in the year 2000 should be somewhere around two billion kilowatts, over thirty times what it is today. At present we are building 200,000 kw generators; what will our generators be like 2000 A.D.? What kind of boilers will we use, or will we use boilers? What course will the development of the gas turbine have taken by the year 2000?

These questions concerning the state of the world fifty years from now cannot be answered with any degree of accuracy and in asking them here we expect no definite answers. We believe, however, that we can predict with some degree of accuracy the course of development during, say, the next ten years, and to that end, we have asked a number of the top power engineers in this country to give us their thoughts on this subject for publication in this issue. This, we feel, is something of an achievement; engineers as a class are not prone to stick their necks out when it comes to predicting the future, so when 21 such men go on record as they have in the pages that follow, and present their ideas regarding the course of power development over the next decade, we can be certain that the predictions are based on substantial ground. The engineers whose statements we present here represent a good cross section of power engineering talent in the United States, covering both the utility and industrial fields, and a broad geographical distribution. L. F. Harza, for example, engaged in a far-off engineering enterprise, cabled his statement to us from Calcutta, India.

TOP POWER ENGINEERS LOOK

GEORGE M. GADSBY

President, Edison Electric Institute. President, Utah Power & Light Co. since 1929, prior to that, President, West Penn Power Co. President of EEI since last June. Has labored constantly in the public utility field since graduation from MIT in 1909. Also an alumnus of Marietta College, Magna Cum Laude, Phi Beta Kappa. Holds degrees, Doctor of Engineering, University of Pittsburgh and LLD from Marietta. While Mr. Gadsby's work has been primarily managerial he has been in intimate touch with power developments.

LEROY F. HARZA

President, Harza Engineering Co. Holds degrees in M.E. So. Dakota State College, 1901, C.E., Univ. of Wisconsin, 1908, Honorary Doctor of Science in Engineering, So. Dakota State College, 1949. Citation for engineering achievements, Univ. of Wisc., 1949. A noted hydroelectric engineer with a world wide range of activity. Present work includes: Chorrera Del Guayabo Project in El Salvador, Scott Falls Project in Ontario, Canada; Consultant, Damodar Valley Corp., Calcutta, India; Nat. Power Corp., Manila, Philippines.

JOHN M. DRABELLE

Chief engineer, Iowa Electric Light & Power Co., Cedar Rapids, Ia. Graduate of Purdue University; advanced degrees in mechanical and electrical engineering from Purdue. Fellow, ASME, AIEE, also Member, Committee on Power Generation, Assn. of Edison Illuminating Companies. Member, Prime Movers Committee, Edison Electric Institute. Author, numerous papers dealing with centralized control in power stations and use of lower grade fuels such as sub-bituminous and lignite coals.

HERE'S WHAT THEY SEE

Larger generating units, with sharp reductions of building space per kilowatt of capacity; simplification, greater standardization, increased sturdiness of equipment resulting in reduction in generating reserves through greater use of full capabilities of equipment and permitting loading of machines well beyond nameplate rating for peak periods as well as improvement in interconnection coordination; increased use of steam turbine reheat cycle, simplified through the use of single boilers and important because of the increased cost of coal due to increases in labor, taxes, and transportation; further application of short-wave radio in system operation and maintenance. Principal effects of these factors during next two or three years will be further improvement in the efficiency of power production per kilowatt sold, and fewer outages for maintenance. Progress in technological design plus the fact that 50 per cent of the generating capacity is less than 10 years old puts the industry in a position to meet the greatly increased power requirements of mobilization to a better degree than in 1941. While the electric industry closely follows and adopts, where justified, new or unique devices and techniques, I foresee technical developments over the next ten years, in general, adhering pretty close to the postwar pattern.

Most important single technical development in the hydroelectric field in last few years has been the increased use of underground power plants. This type has been used in Europe for a number of years, but only recently has its economy been fully appreciated. This economy stems largely from improved rock excavation methods which were developed in Sweden. Underground plants are now being projected in almost every country. ¶ Improvements in designs of control gates are also noteworthy. These improvements are noticeable in the ever increasing size, as well as in type of seals and methods of control. Hydraulically operated gates have been developed and this type of operation will probably become more and more common. ¶ There does not appear to be anything spectacular in view for the immediate future. The developments outlined above are a result of the continuous search for more economical means of developing water power, and do not represent radical changes in the over-all picture. ¶ On a long range basis it appears that the most important development will be a world wide expansion of hydroelectric power into the backward countries. This has already started, and will undoubtedly continue to increase in the foreseeable future.

Ed. Note: Mr. Harza cabled this statement from Calcutta, Ind.

Most important recent developments, revival of reheat cycle because of advantages of higher steam pressures and temperatures; centralized control of power plant operations, particularly those of mechanical nature—combustion, feedwater cycles, etc.; one unit system of one boiler and one turbine, conserving materials, dollars and manpower. ¶ Developments during 1952-53 will be larger turbo-generating units in the 150,000 and 200,000-kw class due to forced hydrogen cooling and new design of field coil windings developed by Allis Chalmers and Westinghouse. Somewhat higher steam temperatures, perhaps 50 deg above present top level of 1100 F, unless alloying materials are restricted by government; more extensive use of vertical closed heaters close to turbine to limit length of piping, and pressure drop, and handling by station crane. More extensive use of desuperheated zone, sub-cooling of condensate to reduce flash losses, and drainer valve erosion and corrosion in drain lines. Use of anion-cation equipment in feedwater treatment and reduction of silica in water and steam by its use. ¶ Next ten years will see further development of use of low grade coals (lignite and sub-bituminous) combined with application of low temperature carbonization process. Greater use of cyclone furnace on account of dust collection problem with pulverized coal.

INTO THE CRYSTAL BALL

RALPH C. ROE

President, Burns and Roe, Inc. Fellow, AIEE and ASME. One of the pioneers in high pressure steam engineering, having designed one of the first 1400 psi power plants in the U. S. He is credited with many improvements in the power plant field, contributing to high efficiencies. The Roe cycle of regenerative heating was one of his developments. Ralph Roe was one of the early advocates of centralized control in power plants, now being used in the latest and most modern power stations.

DAVID MOFFAT MYERS

Myers & Addington, Consulting Engineers, New York. Mechanical Engineer, ME Columbia Univ.; Fellow, ASME, AAAS, member AICE. Cons. Eng. for U. S. Navy, Bu. Yards and Docks 7 years. Cons. Eng. for New York City Board of Water Supply. Continuously engaged in consulting practice in steam and power field since 1907. Specialized in economical supply of power for various industries, steel, rubber, paper, sugar, etc. Advisory Eng. and Chief of Fuel Eng. Div. (volunteer) of U. S. Fuel Administration, World War I. Also cons. eng. to U. S. Bureau of Mines.

H. J. PETERSEN

Head Mechanical Engineer, and Chief of Mechanical Design Branch, Tennessee Valley Authority, Knoxville, Tenn. In charge of mechanical design for 5 new steam plants totaling 4,400,000 kw. Also in charge of mechanical design for hydroelectric program of TVA. Member, ASME, formerly chairman East Tenn. Sect. Graduate, Iowa State College. With TVA since 1937. Formerly with Alabama Power Co., also Safe Harbor Water Power Corp. Contributor of numerous technical articles on power plant engineering to ASME, AIEE, and tech. publications.

Most important recent technical developments, the continued development of large power units for high temperature and pressure operation; development of low cubage per kw plants built around condenser mounted turbo-generators of large size. Savings in first cost and added convenience tend to make these plants comparable in cost with outdoor stations. Condenser mounted turbo-generators up to 60,000 kw have been built. Larger units in offing. Improvements in metallurgy, permitting temperatures of 1050 and 1100 F coupled with pressures of 2000 psi, are going to continue. Expect large units for temperatures of at least 1200 psi in next 2 or 3 yr unless defense requirements prevent. Centralized control rooms will become more standard. Condenser mounted turbines will develop to at least 125,000 kw, perhaps larger. ¶ Next ten years will see higher pressures and temperatures—operating temperatures of 1500 F and pressures close to critical point, in fact *would not be surprised to see pressures go substantially beyond critical point.* Combination of efficient steam power plants and gas turbines worth while and economically sound and will undoubtedly be worked out in larger central stations. Continued research will advance cause of atomic power as source of energy. Stationary gas turbines will come into greater use.

Recent achievements, higher boiler pressures —900 to 2000 psig adopted to provide more by-product electrical energy in manufacturing plants; the installation of a second industrial plant mercury turbine for process purposes with high over-all efficiency; demineralization of raw water for boiler feed; improvement of gas turbine design and efficiency to where it is being used in certain special applications; cyclone furnace, an invention of high order. Along with it has come trend toward the pressurized furnace with its many advantages. Gasification of coal at mines has proved successful in pilot plants and is applicable to shallow seams which cannot be mined economically by usual methods. ¶ Rising costs will stimulate search for more efficient production of heat and power. Higher boiler pressures will be used in industry, pressurized combustion chambers will increase. ¶ Next ten years will see improvements in use of fuels in smaller rather than larger boilers, better, cheaper methods of water conditioning; scientific centralized steam and power loading and dispatching in larger industrial power plants. Any present known methods of atomic power production place it completely out of the picture for industrial applications but it is not unscientific to conceive of a direct conversion of such energy into the electrical form.

Recent advances in design of large generating units, development in high steam pressures and temperatures, increased use of centralized control, the success of the one boiler and generating unit principle together with the new methods of hydrogen cooling for large generators involving hollow or specially shaped field conductors, use of oriented steel which magnetizes better in one direction than in another resulting in smaller transformers point to future steam plants of still larger capacity operating at still higher temperatures and pressures and at even higher efficiency. ¶ The next ten years will bring forth units with 300,000 kw on a single shaft. One company now has a double reheat unit on the drafting board. Steam temperatures of 1200 F and pressures in excess of 3000 psi will be used. Generator voltages will go to probably 30 kv. Forced circulation boilers will become the rule, pressurized furnaces will be perfected and the omission of ID fans, now being tried out, will become more common. Soot blowers, now a necessary evil, will be almost entirely eliminated by better design of furnaces using lower gas velocities. Plants will become more automatic with a consequent reduction of personnel. Atomic power undoubtedly will figure in the power plant of the future, but in my opinion, not on a commercial scale in the next ten years.

TOP POWER ENGINEERS LOOK

JOHN I. YELLOTT

Director of Research, Locomotive Development Committee of Bituminous Coal Research, Inc. The driving force behind the development of the first coal-burning gas turbine in U. S. Holds Bachelor's and Master's Degree in ME from Johns-Hopkins Univ. Spent first 12 yr of professional career in teaching and research at engineering colleges—Rochester, Stevens, Illinois Institute of Technology. Received ASME junior award, 1935; Pi Tau Sigma gold medal, 1940. Engaged in developing coal-burning gas turbine locomotive since May 1945.

CHARLES W. E. CLARKE

Vice President and Consulting Engineer, United Engineers & Constructors Inc. Connected with the design and development of large public utility and industrial power stations for the last 50 years. Fellow ASME, member Institution of Mechanical Engineers (London), Newcomen Society (London). The power industry, says Mr. Clarke, was in its infancy when his connection with it began, and anyone who has participated in its amazing growth is a *lucky fellow.*

H. C. CARROLL

Consulting Engineer. Partner of Carroll, Bechtel and Langtry Division of Commercial Testing and Engineering Co., Chicago. ME, Cornell University, 1903. Member ASME, also member Boiler Code Committee, ASME. Professional Engineer in Illinois, Michigan, Indiana, and Wisconsin. Has been connected with the design, construction, operation and management of private and utility power plants since 1903.

HERE'S WHAT THEY SEE

Among the most important recent technical developments in the gas turbine field is the successful operation of the Alco-G-E oil-burning gas turbine locomotive. This proved that the gas turbine can do a satisfactory job for U. S. Railroads under all kinds of operating conditions. Also, the development of L.D.C. system of coal handling, combustion, and ash removal to the point where a 4250-hp locomotive type power plant has been operated on coal for 170 hr with no blade erosion or deposits. 1200 hr of operation of the experimental Houdry Unit with all kinds of coal. ¶ 1952–53 will see intensified effort to complete the development phase of the L.D.C. Program. The Allis-Chalmers locomotive turbine will be run for hundreds of hours in the Dunkirk test plant and the successful completion of these tests will lead to installation of the power plant in a locomotive chassis for road tests. ¶ In the more distant future gas turbines will operate with cooled blades at temperatures well above today's maximum, reaching efficiencies higher than those of equivalent steam plants, surpassing diesel economy because of lower fuel costs. Pressurized combustion systems using gas turbines to produce power from waste heat will be more widely used in processes and power generation. Gas turbine plants, already dominating high speed air travel, will be extended to marine applications.

Use of large-capacity 3600 rpm tandem-compound generating units and higher temperature-higher pressure reheat cycles, the most important technical developments of last few years. Next few years will see a continuation and expansion of these developments as well as a foretaste of a greater use during the next ten years of the gas turbine. The present status of gas turbines is promising except for two hurdles: 1, until gas turbines can be fired with solid fuel, and 2, until the difficulties now encountered with Bunker-C oil and its objectionable vanadium-oxide content are eliminated (both factors having adverse effect on the life of blades), the evolution of the gas turbine will continue to be retarded. Assuming that these difficulties will be overcome, as have other difficulties in the gas turbine's growth, we can expect intensive and accelerated development within the next five to ten years. At present a number of 5000-kw units are operating or are on order. Many of the latter are to be fired with natural gas which does not have fuel hazards of the kind mentioned.

Rising fuel costs have greatly increased interest in fuel evaluation, not only in its more efficient use in the production of power but also in its distribution. Advancement in standardization of so-called packaged units even to larger sizes has made possible lower steam costs, lower investment costs, and shorter delivery times. High fuel costs also have intensified research into use of waste fuels and the poorer grades of coal and lignite. ¶ With the issuance of more stringent ordinances by civic authorities limiting emissions of dust loadings, smoke, and obnoxious gases, we find additional problems in the generation of steam, particularly where solid fuels are used. This affects the coal industry, the stoker and boiler manufacturers, and the over-all design of all kinds of plants. ¶ Better instrumentation and greater use of automatic control are meeting greater recognition as essential factors in the design of modern boiler units. Increasing use of higher steam pressures and temperatures in industrial plants, especially where large quantities of exhaust steam are used in process work combined with power production, has been noteworthy. ¶ There will be an increase in the use of gas turbines using the more prevalent types of fuel during the next few years and heat recovery possibilities will receive more attention.

INTO THE CRYSTAL BALL

EDGAR J. KATES

Consulting Engineer, New York, N. Y. Diesel and gas engine specialist. Fellow, ASME. Active in engineering of diesel and gas engines ever since receiving his ME degree from Columbia Univ. in 1911. Formerly Chief Engineer, De La Vergne Machine Co. Independent consultant for last 25 yr. Author, Diesel-Electric Plants, Diesel Engine Section of Kent's ME Handbook. Visiting lecturer, Columbia.

GUSTAF A. GAFFERT

Consulting Engineer, member of the firm of Sargent & Lundy, Chicago. Except for a brief interval in teaching mechanical engineering at Worcester Polytechnic Institute shortly after receiving his doctor's degree in mechanical engineering, Gustaf Gaffert has engaged continuously in the design and development of steam power stations. He is a fellow of the ASME and the author of Steam Power Stations.

S. LOGAN KERR

Consulting Engineer, Philadelphia, Pa. Active in many fields, mechanical, chemical, industrial, and management, but known internationally for his work in hydraulics and for his numerous articles on the subject. Chairman of ASME Power Test Code on Hydraulic Turbines, the ASME Committee on Water Hammer, the AWWA Committee on Water Hammer, and Director of the Secretariat, Hydraulic Turbine Com.,

PAUL R. DUFFEY

Chief Supervising Engineer and Consultant on steam-electric power, of The Youngstown Sheet & Tube Co., Youngstown, Ohio. Fellow ASME. Technical education Virginia Polytechnic Institute, University of Cincinnati, and American School of Correspondence. Formerly Chief Maintenance Engineer, American Maize Products Co., Senior Field Engineer, The Babcock & Wilcox Co.,

Belated development of high-compression gas engines with efficiencies equal to diesels one of the outstanding recent technical developments; this principle was first applied to the dual-fuel engine in which a gas-air mixture, after compression, is ignited by injecting oil fuel into the hot mixture. Later it was applied to straight gas engines using spark ignition. ¶ Availability of natural gas in most parts of the U. S., due to pipeline expansion, will greatly increase use of the high-compression gas engine because of its ability to produce power at low cost. ¶ Since gas demand, in general, is highly variable, gas companies will offer attractive off-peak and interruptible rates, which will further increase the use of the new dual-fuel engines. These engines will use cheap gas when it is available, and oil fuel at other times.

The most important technical developments in power engineering in recent years have been: 1, higher efficiency boilers, with the trend toward 90 per cent; 2, reheat application with its improvement in cycle efficiency; 3, the pressurizing of large units to eliminate handling gases, and possibly the application, where applicable, of semi-outdoor plants. ¶ The future effects of these developments will be, A, a continued trend toward reheat; B, simplification of boiler auxiliaries; and C, during the next ten years, a trend toward still higher initial steam pressures —1100 to 1200 F, with a continued effort to obtain maximum performance with reheat, which itself is equivalent to an advance of 150 F in throttle pressure. Increasing interest in metallurgical knowledge also should lead to the production of less costly alloys for high temperature applications.

Few important technical developments in hydraulic turbines in recent years, research having been directed toward improvement in performance. Combination pump turbines have been under development in the laboratory for many years, but more attention is now being directed towards commercial utilization of such units in order to provide *hydraulic storage batteries* for power systems. ¶ General course of power development in the United States will be greatly influenced by political policies over the next ten years. Only if public power agencies and privately owned utilities are able to work together in harmony can the fullest technical usage of our resources be attained.

Developments in Iron and Steel industry in recent years with respect to steam engineering have been greater and more effective use of surplus blast furnace gas for steam generation. ¶ In the immediate future steps will be taken to use not only surplus blast furnace gas and coke oven gas to the economic limit but also coke breeze as primary fuel, with resultant diminished use of purchased fuel. ¶ The gas turbine now has reached a stage of development where it becomes competitive with the steam turbine for many iron and steel manufacturing plant uses, and the present use of blast furnace gas as fuel for gas turbines has proved practical by the success of the installation at the Arbed Division De Dudelange (Luxemburg), Arbed Steel Concern. As a result of experience with this equipment abroad the gas turbine will come into use in this country in iron and steel plants as motive power for blast furnaces, Bessemer blowing equipment, and electric generators within range of gas fuel.

TOP POWER ENGINEERS LOOK

G. V. WILLIAMSON

Steam Engineering Superintendent, Union Electric Co. of Missouri. In steam power work with Union Electric since 1922. Chairman, Prime Movers Committee of the EEI and former Vice-President of the Air Pollution and Smoke Assn. of America. Current activity centered around the development of large boilers in the St. Louis area where million lb per hr class units have been installed at the Venice plant.

WILLIAM P. SAUNIER

Project Manager with Jackson & Moreland, Boston, since 1941; and previously, for 15 years, a sponsor engineer on power plant projects. Was active in reheat, regenerative heating, and pulverized coal design work during the 1920's, and is still active in the development of all these phases of the industry.

GEORGE C. DANIELS

Consulting Engineer, Commonwealth Associates, Inc., Jackson, Mich. Entered utility field with Cent. Ill. Light Co. in 1910, Supt. of Power, 1914. Since 1925, Asst. Chief Mech. Eng. Commonwealth & Southern Corp. and Chief Mech. Eng. from 1928 to 1949 when he became Chief Mech. Eng. and Vice Pres. of Commonwealth Associates Inc. Since July 1951, Consulting Eng. for this firm.

ALBERT C. HUNTER

President, Ralph D. Thomas and Associates, Inc., Consulting Engineers. Mr. Hunter's present work in the consulting engineering field of power engineering has a background of many years spent in the design, manufacture and installation of steam generating equipment for use with North Dakota lignites. His firm recently completed the design and construction of Rural Cooperative Power Association's Elk River Plant.

HERE'S WHAT THEY SEE

Most important developments of past few years, development of large boilers for use of all types of coal. The million lb per hr boilers at Venice have been extremely successful, producing 1,100,000 per hr or 20 per cent over the 900,000 lb design rating. Success lies in proper design of water walls to absorb 70,000 to 85,000 Btu per sq ft per hr, and use of divided furnaces. ¶ Success of such large units point to even larger ones. With single-shaft 200,000-kw turbines on order and 300,000-kw in sight with hollow conductor generators, spectacular possibilities are imminent. ¶ Next ten years will see wide use of 200 to 300,000-kw units; there will be great stress on simplicity of design, duplicate auxiliaries will nearly disappear, building walls and roofs will diminish, with increasing proportion of equipment outdoors. Thermal efficiencies will increase by use of temperatures even higher than 1200 F and re-superheat in two stages will be tried. Finally, power from atomic energy.

Most important recent developments, common acceptance of the 1450 psi, 1000 F cycle and use of 1800 psi, 1050 F cycle by some companies; return of reheat at these higher pressures and temperatures; development of hollow generator conductors using high pressure hydrogen cooling; and, complete demineralization systems for boiler feedwater treatment. Demineralizing can be adapted quickly, replacing evaporating equipment. Internally cooled windings, a considerable departure from conventional practice so adoption may be slow until techniques are worked out. ¶ Over the coming decade, development of higher temperature metals will permit use of still higher temperature and pressure cycles. Difficult to predict future of reheat since it may be discarded with another significant increase in stream temperature as it was in the 1930's. Strong likelihood that reheat cycle will continue, however. Internal cooling of generator conductors will more than double size of units.

Significant developments of last few years, the advances in metallurgy which made possible steam temperatures of 1050 F; the use of reheat at the higher pressures and temperatures now in use; and the general use of large 3600 rpm generating units. These have reduced the unit costs of power plants, a factor highly essential with rapidly rising construction costs. ¶ Next few years will bring about new advances in metallurgy leading to still higher steam temperatures. Rapid increase in load and further interconnection of systems will result in construction of plants with larger generating units at locations where circulating water is available rather than close to load centers. ¶ Technical developments during next ten years will center around greater reliability of power equipment and more rapid starting of boilers and turbines. There is nothing at the present time to indicate that the heat rate of modern plants cannot be materially improved.

Among the more important developments in the north central section of the country is the research by the Bureau of Mines at Grand Forks, N. D. laboratory, leading the way to the development of commercially practical methods of producing both liquid and gaseous fuels from lignite. Unrelated to this work at present but of future significance is the development of the gas turbine, which will be the most economical unit for utilizing these fuels. ¶ While these separate developments will not have an immediate effect of power generation in the lignite field, it is not unreasonable to expect, within a normal ten-year period, to have a base-load station in operation with gas-turbine generator units supplied with fuel produced from North Dakota lignite.

INTO THE CRYSTAL BALL

M. NEWKIRK

Power Manager, Dow Chemical Co., Midland, Mich. Technical education I.C.S. Came to Dow Chemical Co. in 1915 as Erector of German type, American made, Locomobile Steam Power Plant. Developed and patented several stoker improvements, especially over-feed spreaders. Member ASME, NAPE, AIEE. Registered Professional Engineer, State of Michigan.

EDWIN R. LITTLE

President of the E. R. Little Co., Detroit, Mich. Consulting and designing mechanical engineer since 1918. Graduated 1913, University of Michigan. Registered Mechanical Engineer, specializing in the engineering of Institutions, i.e., power plants, distribution systems, heating, lighting, etc.

F. L. BRADLEY

Plant Engineer, Fortsmann Woolen Co. Massachusetts Institute of Technology, 1920. Member, ASME; Chairman Power Division Executive Committee, ASME; Member of Steering Committee for revision of ASME Rules for Care of Power Boilers; Member, Plant Engineers Association, New York.

C. MAXWELL STANLEY

Senior partner, Stanley Engineering Co. Muscatine, Iowa. Graduate, Univ. of Iowa. His firm is active in power plant and utility work for industrial organizations, municipalities, and cooperatives. This engineer of 47 parallels his technical work with concern and activity for professional problems of engineers, and for responsibilities of engineers as citizens in a dynamic and scientific age.

Outstanding recent achievements, High-pressure steam generators using crushed coal in pressurized combustion system; pressure blowers handling only cool, clean air and delivering high temperature air to Cyclone furnaces with marked reduction in fly ash and giving high overall economy; demineralized boiler feedwater and chemical cleaning. ¶ Next few years will bring forth methods of using coals not considered economical in the past, and improved placement of heat absorbing surfaces in boilers with consequent improvement in economy. ¶ In the next decade we can expect still higher pressures and temperatures with reduction in rejected heat to condensers and flue gases; steam generators without drums; turbines placed directly on boilers; 7200 rpm turbogenerators, governed from frequency of the generator; more compact plants; less buildings and more remote control; better feedwater; and reduction in material per kilowatt of capacity with less capital investment.

Important recent development characterized by the notable improvements in combustion and control equipment. Use of oil, gas, and coal as interchangeable fuels has created a problem for the operator in securing efficient combustion with each fuel unless he has available something better than the air flow-steam flow meter. Rising fuel costs have drawn attention to the need for improvement in combustion efficiency, and some of the new instruments and control systems can make noticeable savings, particularly in smaller plants—those producing 75,000 to 100,000 lb of steam per hr. ¶ Next ten years will see a continuance of this trend in the further development of combustion equipment and control systems. The improvement effort by manufacturers of this type of equipment will be given added impetus by the progress made in the development of atomic power.

Among the important developments of recent years, first is the work of Detroit Edison in minimizing fireside deposits in boilers through humidification of combustion air. This compares in importance with the chemical cleaning of boilers and heaters in its effect on availability of equipment for service. Second, is the research and development in cooling tower technique at a time when we face a reduction in water supplies. ¶ Humidification of combustion air provides power engineer with means of controlling the fouling of his heating surfaces. Cooling water supply can be deciding factor in the selection or rejection of an otherwise dependable site for an industrial plant. ¶ During the next ten years the general course in technical development may see more extensive use of the cyclone furnace, fired pressurized steam generator, the combination of the gas turbine with waste heat type boiler for recovery of heat in the exhaust, and more extensive designs to eliminate the fly ash problem.

Tremendous increases in the use of electrical energy in the home, on the farm, in the store, and in the factory are resulting in an unbelievable increase in requirements of power systems. This means substantial expansion of generating plants, and of transmission and distribution systems. Accomplishing this expansion at high cost levels emphasizes the need of careful planning, economical design and efficiency.

U. S. POWER INDUSTRY

Unless more steel and copper becomes available for equipment and plant construction, some four million kilowatts of new generating capacity scheduled for 1952 will not be completed. Some regions, because of diminished hydroelectric power, will have less dependable capacity than the expected peak loads

IN MANY WAYS, the year just past was a notable one in the history of power development in the United States. Not only did we add more generating capacity to the already huge plant of the country than we ever did in any one year, but we produced power at a higher rate than we ever did before. In the week of February 3, 1951, for the first time in history, the electric generating stations of the United States turned out over *seven billion kilowatt-hours* in a single week. Again, during the month of August 1951, the electric utilities produced a record output of 32,326,489,000 kilowatt-hours. This is approximately as much electric power as was produced in this country during an entire year, in 1919.

For the year ending September 1951, the combined utility and industrial power plants produced 423,033,900,000 kwh — an amount 13.6 per cent above that of the previous 12-month period. This output was obtained by means of an installed generating capacity of 74,291,432 kw in central stations, and 14,114,559 kw in industrial power plants, a total of 88,405,991 kw. This takes into account only the power in industrial power plants involving electric generation. To this total should be added 7,800,000 kw in direct mechanical drive in industrial plants. Thus, the total installed power producing capacity in this country is 96,205,991 kw, just a trifle short of 100 million kilowatts.

Steel

At the same time, the leaders of the steel industry tell us that our steel-making capacity has reached a total of well over a hundred million tons a year, at least $2\frac{1}{2}$ times as much as we have reason to believe the Soviet Union and its satellites can produce annually. And by the end of 1952, our steel productive capacity will be 118 million tons.

Now, steel and power are the two essentials that help to win modern wars, indeed, it was no less an authority than Marshal Stalin himself, who, during World War II, pointed out that victory would go to the country with the most horsepower. So, with $4\frac{1}{2}$ times Russia's power output and $2\frac{1}{2}$ times its steel-making capacity, it would seem we have little to worry about.

But the beginning of the year 1952 finds us sorely beset with all sorts and manner of woes and worries. Despite our high productive capacity in power, in steel and manufactured goods and in agricultural commodities, we are far from happy. We have more money than ever before but we find it also goes faster than ever before. And, we have less freedom. Time was, when you could drive your car or jalopy downtown, run it to the curb and park it there. But no more. Now you park it in front of a parking meter and drop a nickel in the meter and you had better be back before the hour is up, or you have to run your car into a parking lot or garage, which costs you money. The reason for this restriction on your liberty is more people, more cars, more of everything including more complexity.

Power Outlook Not Too Good

It is not for us to try to discuss these world social and economic problems. All we intend to do here is to point out that the problems which beset the world have their repercussions in the power industry. Despite the splendid record of the power companies in never having had a real power shortage in this country, this year we can expect more or less severe shortages in several areas, particularly in the Pacific Northwest, which already has been hard hit in recent months. Indeed, unless drastic measures are used to install more capacity in that region, there will be a power shortage through 1954.

According to the tenth semi-annual survey of the Edison Electric Institute, released recently, on a nationwide basis, the margin of generating capacity for 1951 was approximately 9 per cent. All regions had some margin, except the Pacific Northwest and parts of the Southeast already mentioned. Severe drought in both of those regions cut down the amount of hydroelectric output. If the drought in the Southeast continues it is quite possible that the adjacent central industrial area could be forced into curtailment of less essential uses of electric power during the next six months. The Southeast is tightly connected with the power systems between the Great Lakes and the Gulf and if there is a severe shortage of power in the Southeast, power will be drawn from the central area. The only reason we had as little trouble as we did last year was because the equipment due in the last half of 1951 was too far advanced to be affected much by the material cutbacks during the last half of the year.

Effect of Cutbacks

This year, 1952, however, presents a different picture. Cut backs will seriously affect the amount of new capacity that will be installed. According to the studies made by the Edison Electric Institute of manufacturing and construction schedules, unless more steel and copper becomes available for equipment and plant construction, some 4 million kilowatts of new generating capacity scheduled for service by the end of 1952 will not be completed. This amounts to nearly half of the new capacity scheduled to be added in 1952. The EEI survey also indicates that the slippage from the construction schedule could amount to a cumulative total of 7 million kilowatts of generating capacity by the end of 1953. These estimates are based, in part, upon the time already lost in the manufacturing of certain major equipment and upon problems now being encountered in obtaining steel for plant construction. If these materials cannot be obtained, reserve margins for 1952 would be cut as low as 3 per cent from the expected 12 per cent reported in the EEI survey released last April, and in 1953 would be cut to 5 per cent from the expected 16 per cent.

This critical state of affairs is the direct consequence of allocation policies and the dispute between DPA and the power systems over estimates of loads and materials required. The power industry, for months, has insisted that unless it is given the material and equipment it had planned for, the industry will not be able to meet the demands that will be

FACES LOWER RESERVES

made on it. DPA, however, has never quite trusted the load estimates of the power industry and that is why, under continued pressure, DPA recently set up a committee of experts to review the power program. Members of this committee include Ralph Booth of Jackson and Moreland, E. W. Morehouse, vice president of General Public Utilities Corp., G. O. Wessenauer, TVA power manager and Herbert S. Marks, Washington attorney, counsel for the Office of War Utilities in World War II. These are all good men and the power industry can have full confidence in their findings. Even if this committee OKs the existing program, it will not relieve the immediate situation, because it may be too late to reestablish the cutbacks in time to provide the minimum reserve throughout the nation to prevent local power shortages.

Barring severe droughts in the hydroelectric areas, the 3 per cent reserve might see us through without too great disturbances. If necessary brownouts can be imposed and all year 'round daylight savings reestablished, though neither of these measures will save more than a negligible amount of power. More power also can be fed across interconnections, and one-shift industries could be forced to operate between 6 pm and 9 am.

Whatever shortages might develop, the power industry cannot be held responsible. The leaders in the industry have done an outstanding job, not only in building up our reserves after World War II but in trying to anticipate future loads. For five years, the industry has vigorously prosecuted its huge expansion program, unmatched in industrial history, by raising its total generating capacity of 50 million kilowatts at the end of World War II to 75 million kilowatts at the end of 1951, and by taking steps to add 26 million kilowatts over the next three years.

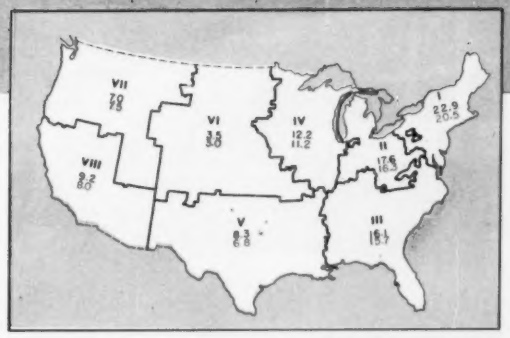
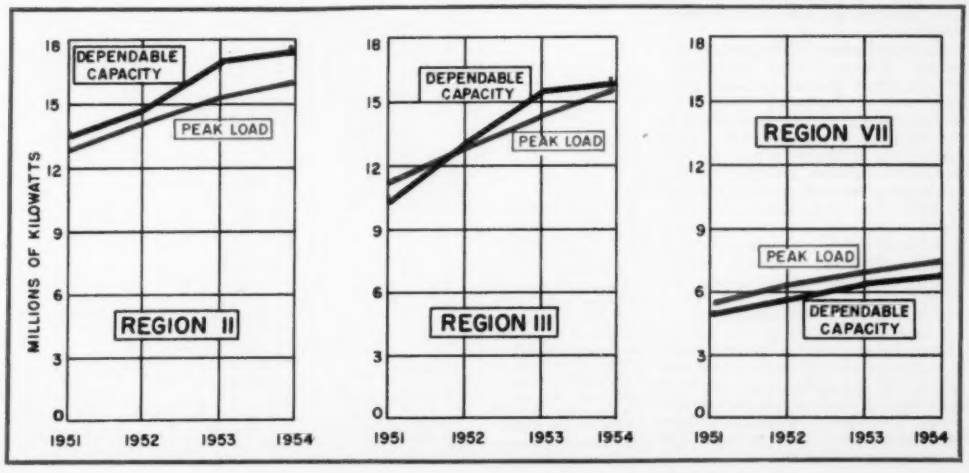


Fig. 1. The Power Industry in the United States in 1954.
Total dependable capacity....96.9 million kw
Peak Load .....88.8 million kw

The Power Industry in 1951

(millions of kw)

Region	Dependable Capacity	Peak Load
	18.1	16.0
II	13.3	11.7
III	10.0	9.5
IV	9.1	7.9
V	5.8	4.1
VI	2.6	2.0
VII	4.8	4.9
VIII	7.1	5.6



Future Power

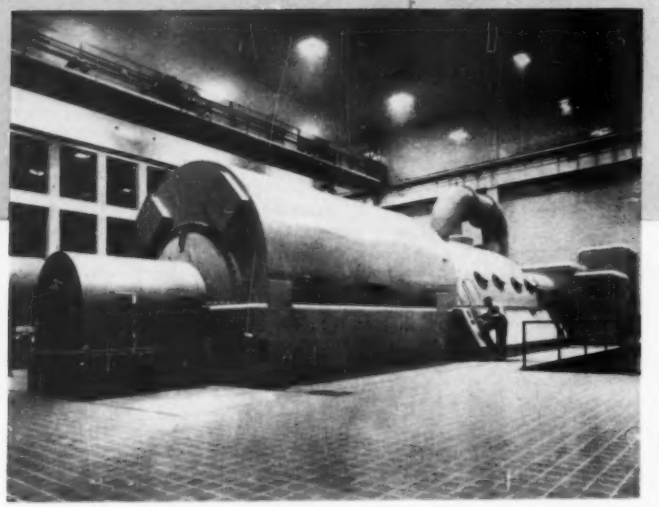


Fig. 1. Here is one of the sleek modern 100,000-kw single-shaft turbine generators, recently installed by a Midwestern utility

By CHESTER R. EARLE
Managing Editor, POWER ENGINEERING

UNTIL VERY RECENT years, the primary objective of the power industry has been to obtain more kilowatt hours per pound of fuel — that is lowest Btu per kilowatt-hour. However, for the present, and perhaps for an indefinite future, according to a recent statement by William F. Ryan, the problem is to gain more kilowatt-hours per dollar invested.

The electric power industry as a whole has been very much aware of this new problem and here are some of the new strategies it is adopting to cut costs of the plant to a minimum and develop more kwh per dollar.

General Design: — Much has been done to simplify station layout, although the apparent simplicity of modern plants belies the fact that some individual equipment units and their controls are somewhat complicated.

Building costs as such have not decreased. But as POWER ENGINEERING has often pointed out, one principal way of bringing down high construction costs of power plants is the outdoor or semi-outdoor power plant. The ultimate in such plants, formerly considered suitable only for the South, was apparently reached in 1950 when a completely outdoor plant, with only the portion below the operating floor housed in, was built at Billings, Montana, where during the winter the temperature often reaches −40 F. It is shown in Fig 5. (See July 1951 issue.)

In many recent completely-housed plants, brick walls have been eliminated in favor of insulated metal wall panels. In some cases, grilles have been used instead of poured concrete floors. Turbines on island foundations have sometimes cut the cost, the floors being omitted.

Building costs in newest plants are now a lower proportion of total plant cost because equipment costs have risen, also because of increasing compactness and use of outdoor design.

The one-boiler-per turbine design is becoming almost standard for new plants, unless there are some unusual factors.

Large Boilers: — Another important method for increasing kwh per dollar is the development of the large boiler for all types of coal, including Midwest coal. Now, because of various recent developments, extremely large boilers can be built both in the natural-circulation and forced-circulation types. Boilers of well over 1,000,000 lb per hr steam output from a single unit are now in service and more are projected. If single turbine generators, of 175,000 kw or 200,000 kw may be in sight, using the hollow-conductor type generator (November issue), and if single boilers can be constructed capable of supplying them, then as G. V. Williamson points out, spectacular possibilities are ahead.

Controlled-Circulation Boilers: — For producing more kwh per dollar, one boiler manufacturer now has on order 18 large, high-pressure steam generating units of the controlled-circulation type (see Fig. 2), for 9 central stations in this country. These units, all ordered within the last 15 months, range in rated output from 750,000 to 1,450,000 lb of steam per hr (100,000 to 200,000 kw) and in design pressures from 1670 to 2650 psig. All employ reheat of 1000, or 1050 F, and initial steam temperatures range from 1000 to 1100 F. Each unit will serve a single turbine generator.

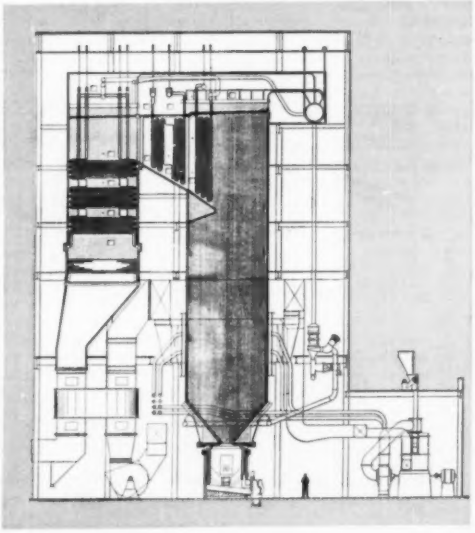


Fig. 2. Cross-section through one of new controlled-circulation steam generating units, 18 of which are now on order. They range in rated output from 750,000 to 1,450,000 lb per hr, in design pressures from 1670 to 2650 psig, 1000 to 1100 F initial temperatures. All are reheat units, reheating at 1000 or 1050 F. Each will serve a single turbine generator

Plants Must Yield More Kwh per Dollar

Power plant construction costs up 70 to 75 per cent from pre-war . . . Larger natural and controlled circulation boilers; steam conditions up to 2650 psig, 1100 F, for one-boiler-per-turbine units of 150,000 to 200,000 kw . . . Better coal combustion; more oil and gas use; b-f gas for base fuel; wood waste; pressurized boilers; resurgence of reheat . . . Moist combustion air; spreaders tokers; smoke abatement . . . Larger turbines; more preferred standard units; improved blading and metals . . . Demineralizing feedwater; cooling towers and air-cooled condensers . . . More gas turbines . . . Pumped storage hydro . . . All add up to more power from higher investment required for modern power plants

After 10 years' experience with the first units of this type, the early operating problems have been solved, and the units are expected to offer many advantages in reduced thermal stress in the comparatively thin-walled tubes, positive circulation and very flexible arrangement of heating surfaces, great reduction in weight of pressure parts for a given output, and reduced volume.

The dual-circulation boiler also makes its contribution to more kwh per dollar by permitting operation of the highest temperature sections of the boiler at low concentration, thus minimizing outages and decreasing maintenance.

Steam Temperatures: — As J. R. Carlson points out in *Westinghouse Engineer*, the rise of 50 deg to 1100 F comes close on the heels of the increase from 1000 to 1050 F. If experience with 1100-F machines now on order is good, a further step is probable, because the stainless steels are more than 50 deg better in creep strength than the ferritic materials used for 1050 F. However, the climb in temperature cannot continue indefinitely. At 1200 F, 3206 psi, water and steam are equally dense. The gain in economy in approaching or exceeding this critical condition may be more than offset by the increase in cost of obtaining it.

Turbine Generators: — Bigger and better by the dozen, they form another weapon in the battle for more kwh per dollar. Quantity of large machines under construction is astounding. In the 12 months prior to last August, one manufacturer alone was working on a total of 88 turbine generator units of 10,000 kw and larger, totaling 5,259,000 kw. This company has announced its readiness to build single-shaft 3600-rpm generating units capable of delivering 150,000 kw. Two still larger ones are under construction; one is a 185,000-kw machine, the other a 200,000-kw machine. Both these giants are 3600-rpm, triple-exhaust, single-shaft tandem units. General trend today is towards the single-shaft 3600-rpm machine. Condenser-mounted turbines save space indoors, lower costs; sizes up to 60,000 kw now, may go higher.

Average size of utility turbines increased from 35,000 kw in 1947 to 52,000 kw in 1950. But the average industrial steam turbine is in the range well below 10,000 kw. However, this year has seen two extremely large industrial steam turbine generator installations. One is the new 60,000-kw, 900-psi, 900-F condensing unit at the South Works of U. S. Steel Co. (*NEWS REEL*, this issue). This is served by one 650,000-lb-per-hr boiler. Another even larger industrial generating unit is an 80,000-kw machine for a chemical plant in Ohio.

Furnaces: — Many types of furnace constructions also make their contribution to efficiency of coal burning and increase of capacity per dollar. One is the adjustable furnace, using tilting burners, which provide a good measure of superheat control so necessary at present high steam temperatures.

Another is the increasing use of the cyclone furnace, particularly with midwestern coals. An installation of the cyclone furnace is to go into operation early in 1952 in the East to burn an eastern coal. As a matter of fact, cyclone furnaces have very wide adaptability and many fuels have been burned in them successfully, even including lignite. They will also burn gas, alone or simultaneously with coal.

Still another development for getting more kwh per dollar, which has been developing slowly for a good many years, is the pressurizing of boiler furnaces, long popular in marine steam practice. Object is to decrease boiler volume and metal, eliminate or minimize use of the induced-draft fan, reduce auxiliary power, and so on, although there is little difference in efficiency. See July 1951 issue.

Resurgence of Reheat: — Superimposed upon the present high-pressure high-temperature steam cycles, reheat is another weapon for more kwh per dollar. By adding 4 or 5 per cent of thermal efficiency to that obtainable by high-pressure, high-temperature operation, the result is, of course, more kilowatt-hours from the

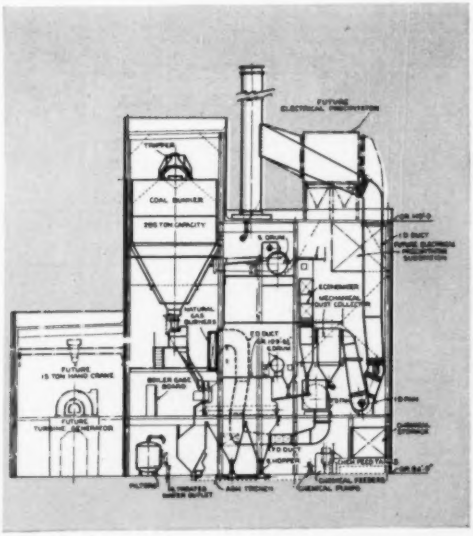


Fig. 3. Typical 1951 industrial boiler plant. Many industries install steam plants of this general type, sometimes including steam turbine generators, sometimes using steam only for process and heating. This plant contains three 80,000-lb-per-hr, 200-psi, 450-F spreader-stoker-fired boilers. It cuts fuel bill by ⅓ and power plant labor in half (See PE, October 1951)

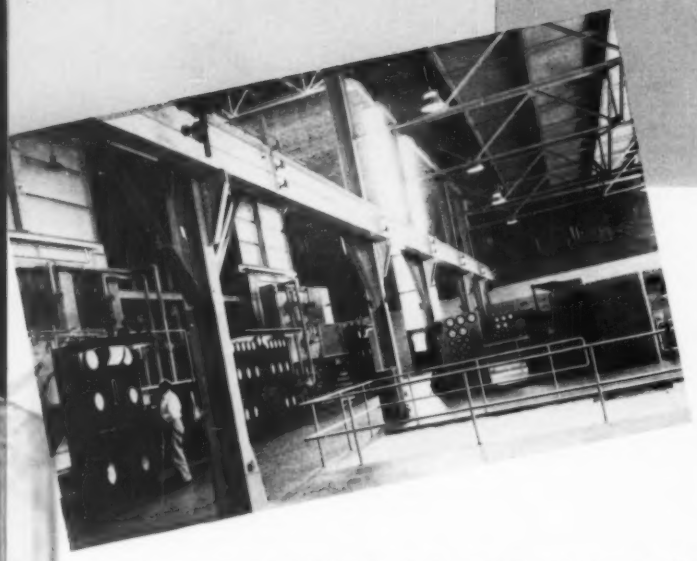


Fig. 4. General view on operating floor of new power plant serving a large university. Two 50,000-lb-per-hr, 425-psi, 725-F boilers, two 2500-kw condensing extraction turbine generators. (See PE, October 1951)

same equipment. During 1950, 26.6 per cent of the total kilowatt capacity installed was designed for reheat. Many of the problems in the boiler design and operation involved in reheat have been successfully worked out, and the entire reheat technique has, of course, been tremendously simplified by the one-boiler-per-turbine development. See March 1951 issue.

In reheat turbines themselves, one new development is the rearrangement of the turbine so that the high-pressure element is turned end for end, with the throttle end adjacent to the inlet of the intermediate pressure element, and with the reheater between them. Thus the high-temperature parts of the turbine are concentrated at one point. In another design, the thrust bearing is between the high and intermediate-pressure elements, giving better thrust balance with smaller balance pistons.

Small turbines are being used for increasingly high steam pressures. Consequently steam volumes are smaller, making it more difficult to obtain high efficiency. This results in use of impulse turbine construction with partial admission stages at reduced cost, instead of the traditional impulse reaction arrangement for ratings through 15,000 kw.

The turbine standardization idea is growing steadily in favor as attested by percentages of standard machines purchased from one manufacturer as follows: 1947 — 17.8%; 1948 — 50.1%; 1949 — 65.6%; 1950 — 74.4%; 1951 (8 months) — 82.0%.

A single large, sleek turbine generator sits in isolated majesty on a large turbine room floor but underneath that floor is an elaborate system of heaters and piping. Anything that can simplify this is a gain. One move is to place some of the feedwater heaters in the neck of the condenser.

Fuels and Firing: — The spreader stoker continues its onward march in the industrial field. When properly equipped with overfire air jets, cinder reburning devices and suitable dust collectors, the spreader stoker has shown its ability to burn many different types of fuels and a wide range of fuels in a single installation, without undesirable dust emission.

There is a great interest in combination firing of other fuels, such as various wood wastes, also gas and oil, in spreader-fired furnaces. In one installation very wet bark, laden with sea water, was prepared by pressing the water out of it with sugar cane mills and firing the resulting product in suspension over coal-fired spreader stokers. Most new plants are designed for burning coal, oil or gas in various combinations depending on supply and price fluctuations.

Another interesting development is the increasing use of blast furnace gas as a base fuel in various steel mill installations. A notable case was at Youngstown Sheel & Tube Co., July 1950 issue. Another is at the new plant for the Fairless Steel Works, October 1951 issue, and another is reported in *NEWS REEL* this issue.

Prevention of fireside deposits by humidification of combustion air, as tested by the Detroit Edison Co. on underfeed stokers, has aroused much

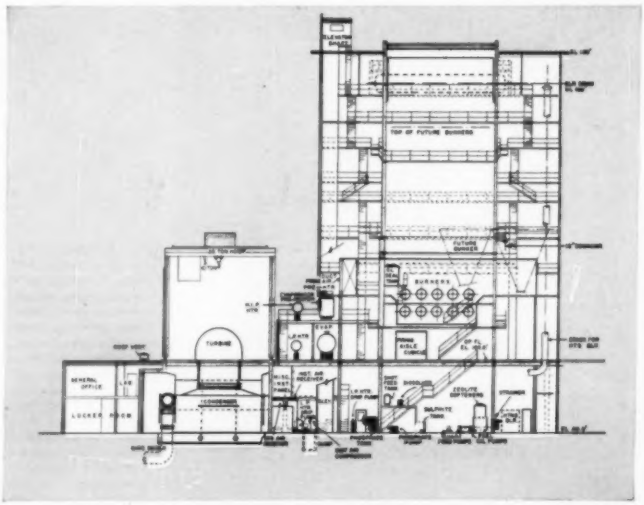


Fig. 5. Cross-section through the ultimate in outdoor power plants, installed in Montana where winter temperatures drop to —40 F (See PE, April 1951)

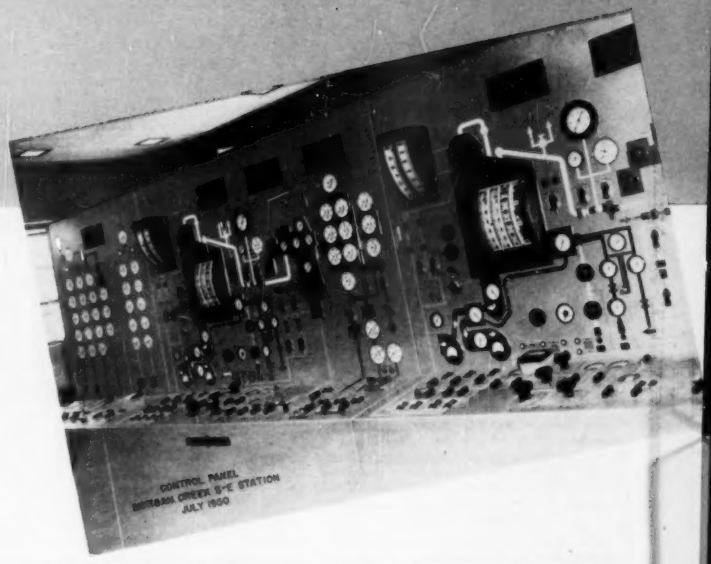


Fig. 6. This control panel gives complete centralized control of two 220,000-lb-per-hr, 1000-psi, 905-F boilers, each serving a 20,000-kw turbine generator, at a Southern outdoor power plant. Note small-sized indicating instruments located on diagrammatic panel, and operating controls in front of them on benchboard. Recorders on back of panel. At left is electrical control for station. Thus one man at this panel controls entire station

interest throughout the field this year. Further work is being done on it.

Cooling Water: — Much is being done to solve cooling water problems in modern plants, not only in treatment of cooling water to prevent corrosion and scale troubles, but also in providing adequate supply. Just as important, use of standard types of cooling towers and also of air-cooled condensers (see October issue) permits location of plants in places where no adequate natural water supply is available. This possibility comes at a most opportune time, in view of prevailing water shortages in many sections of the country.

Feedwater Treatment: — In the boiler water circuit, treatment of feedwater is a major activity and great strides have been made in this respect during the past two or three years. Two important developments are, first, the use of ion exchange resins, either alone or in combination with other processes, to produce commercially pure distilled water for boiler makeup; and second, possibility of substituting a complete demineralizing system (treating boiler feedwater by outside means before it enters the boiler) for the evaporation process of supplying boiler feed makeup used in the regenerative cycle.

Use of phosphoric acid for cleaning of large boilers is another recent development that shows much promise. (See August 1950 issue.)

Of particular concern in industrial plants is the prevention of return line corrosion in large steam distributing systems. Several amine treatments are used as preventives; some control the pH of the condensate, another deposits a very thin protective film on the return piping metal, protecting it against both oxygen and CO_2 corrosion. Deaeration and other suitable water treatments are mandatory in most cases.

Oil in condensate returns to industrial boilers has been a serious problem but in the last 2 or 3 years a successful method of combatting it has been worked out. This is to use pressure filters, which may be suitably coated with diatomaceous earth to absorb oil from the water and may then be cleaned at suitable intervals, inserting a fresh supply of the absorbent. See April 1951 issue. This may make possible the use of exhaust steam from prime movers that otherwise might have to be wasted because of its oil content.

Power Plant Control: — A revolution has been occurring in the whole field of power plant instrumentation and control, brought about by the need to decrease labor costs and by the need for centralization of control in outdoor plants and in modern one-boiler-per-turbine designs. There is still some controversy as to how much centralization of control is advisable, but the practice is growing steadily in all types of plants, even in industrial plants.

To promote and improve control centralization, new types of combustion control are developing, incorporating electrical and electronic links for connecting masters and actuators, to eliminate transmission lags caused by greater distances in modern plants and also increase accuracy and speed of response required by modern equipment. Moreover the manufacturers are developing smaller

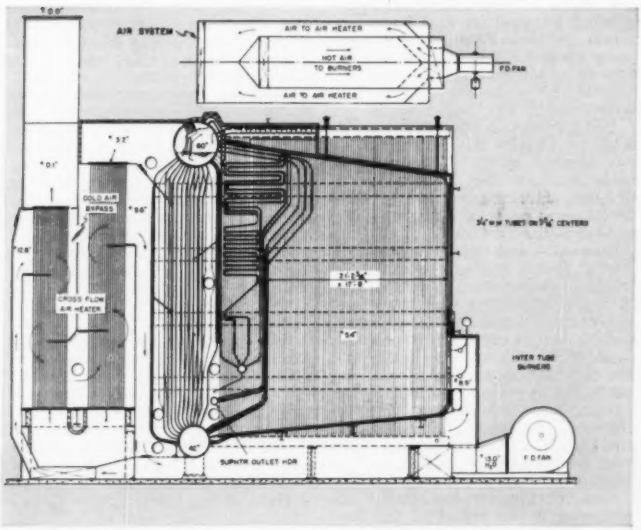


Fig. 7. Cross-section through new pressurized steam generating unit, 200,000-lb-per-hr, 1000 psig 850 F, for natural gas firing (oil auxiliary) installed at a refinery. No ID fans; furnace to operate under pressure of 5.4 in H_2O (See PE, June 1951)

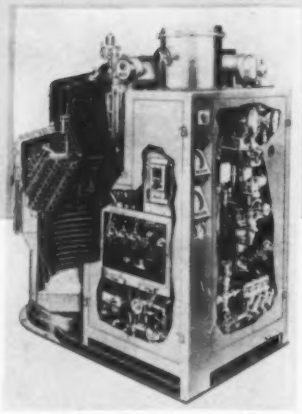


Fig. 8. Contrast this little controlled-circulation steam generating unit with Fig. 2. This is one of the well-known diesel train heating units, recently installed for first industrial service. It generates 4500 lb of steam an hour at 250 psi, burns diesel oil, under complete automatic control. (See PE, September 1951)

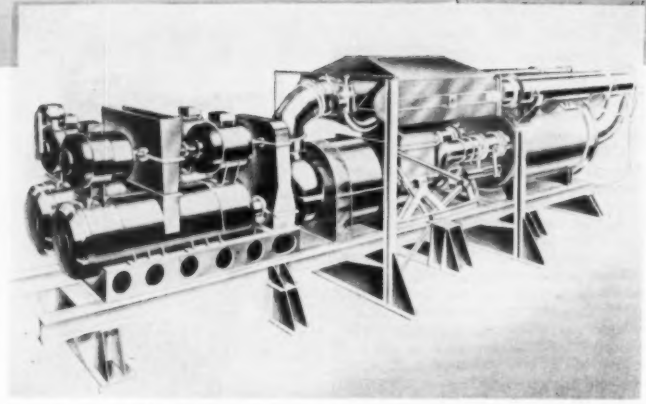


Fig. 9. Here is the 4200-hp LDC coal-burning gas turbine as set up for test at Dunkirk. At this writing, it has operated for 170 hr on coal, there is no sign of turbine erosion, and no deposits. (See PE, July 1951)

indicating and controlling devices in order to permit more compact control boards.

Figure 6 illustrates the latest development in centralized control for a 2-boiler 2-turbine station. This particular board features a diagram of the principal steam, water and electrical circuits of the station with the small or miniature indicating devices shown on the diagram at their same relative positions as in the circuits.

The value of these diagrammatic boards in a power station is still a subject of much debate, for many engineers believe that the place for the diagram is in the operator's head, not on the board. However, Fig. 6 also shows another important point: — separation of operating and indicating devices from the recorders of historical data, which may be on the back of the panel or on a separate panel. A step further is use of color-coded instruments, in a few of the very newest plants.

Separation of operating and recording functions is made easier by various electrical and pneumatic transmitters that can transmit indicating and control impulses to several points at once. Thus only relatively low-pressure air piping or electrical circuits need be led into the control room.

Another important aid in centralized control is the wired television system. This is being used widely to permit remote observation of boiler water level on large, high boilers. It is also very useful in observing furnace conditions, checking pilot and main burner operation, observing slag drainage and the like, in a control room remote from the unit.

Hydroelectric: — One of the year's biggest advances in promoting more kwh per dollar is the announcement of a new vertical, single-runner, pump turbine, which can be used rotating in one direction as a hydraulic turbine driving a generator; then the generator can be converted into a motor to drive the unit in the opposite direction as a pump, to pump water back up into the reservoir. By pumping water with low-value off-peak power from an outside source, the installation acts like a storage battery, storing up the energy in the form of water for generating power during high-value peak load periods.

A pump turbine unit of this type is being installed on a western hydraulic project. Proposals are also being made for use of units of this type in a pumped storage plan as part of the re-development of Niagara Falls by the United States.

The subject was discussed in great detail by Charles H. Spink in a special 12-page study of the subject made specially for POWER ENGINEERING and abstracted in the October issue. Copies are available on request to the Editors.

Internal Combustion Engines: — The dual-fuel engine continues its progress, as previously recorded, setting new records for economy where gas from the expanding gas pipe line system can be made available to it. Another development is that of the use of standardized diesel plants on big utility systems. During the year a report was made on how 27 standard diesel engines in plants of standard layout and arrangement were used on one big utility system to supply peak load power very quickly.

Gas Turbine: — Especially encouraging is the report in the July issue of tests on the coal burning gas turbine locomotive at Dunkirk, N. Y. It showed that the problem of ash separation has been solved for all practical purposes. The full-scale gas turbine locomotive unit has now been in operation on coal for somewhat more than 170 hours, burning about one ton of coal per hour. There is no indication of any build-up of deposits on the turbine blades or in the separator that could possibly cause any trouble, and it is expected that this work will be pressed forward because it is so close to success now.

Two gas turbine locomotives are now in service on railroads in this country, both burning Bunker C oil. A report on one of these was given in the November issue.

Four stationary gas turbine units for electric generation are also installed and piling up operating hours and experience. Two of these are 5000-kw regenerative units, with an unusual straight-line arrangement of high and low pressure turbines. One forms the initial unit of the first utility power plant designed for all-gas-turbine operation. In addition, this is the first complete independent installation of this type unit solely for power generation. See March 1951 issue.

One manufacturer has orders for a large number of gas turbine compressor units for gas pipeline pumping. Other manufacturers' units of this type are in successful operation on gas pipelines. One manufacturer has an order for a 15,000-kw gas turbine generator for delivery in 1954.

In short, development of the gas turbine as our fourth prime move is now commercially assured.

How CMP Governs Today's Power Plant Buying

Under the Controlled Materials Plan (CMP), the mobilization authorities are trying to allocate critical materials to the utility and the industrial power projects and equipment so the United States will get necessary increased power at the right place and time, considering over-all national interest first

BEGINNING July 31, 1951, planning and purchasing of power plant equipment have been governed by the Controlled Materials Plan (CMP) set up under the National Production Authority (NPA), a part of the Department of Commerce. Utility power engineers have had to deal with Defense Electric Production Authority (DEPA) under the Department of the Interior working with NPA. Latest development is appointment of advisory committee to review and advise on requirements and expansion plans.

Why CMP?

Steel, copper and aluminum are the metals in tight supply, and are those most widely used in industry. By controlling these, NPA mobilization authorities not only can assure their equitable distribution in the best national interest but also direct production in general and influence use of other critical materials. Here is the way it works as this is written in November.

How CMP Works

Briefly, users of steel, copper and aluminum estimate and file their needs for a specified period (now a quarter of a year). The mobilization organizations compare total of these needs with their estimates of supply. They can then allot all or part of the requirements to the users on the basis of relative needs and urgencies. No one buys controlled materials from a primary supplier except by a CMP allotment.

A and B Products

Under CMP are two classes of products: A products are those of special design or special use that are sold to a relatively few customers: for example, most military and AEC equipment are A products.

On the other hand, B products are industrial or civilian items of more or less standard design. Practically all units of power equipment — boilers, turbines, compressors, motors, switchgear — are B products.

Construction materials, tubing, pipe (unfabricated) and similar general power items are neither A nor B but simply controlled materials.

How Utilities Operate Under CMP

They file a project statement with DEPA, claimant agency for electric utilities. DEPA's responsibility is to see that the nation gets the power it needs where it needs it most for the best general over-all interest and with minimum use of critical materials.

A utility must justify its requests to DEPA on this basis. If DEPA approves, utility may apply rated orders, to which suppliers of equipment and materials must give preference.

How Industrials and Institutions Operate Under CMP

If they plan a power project of more than 2000 kw capacity, they file a report with DEPA, which determines if existing facilities can supply the power. If not, DEPA advises NPA, which adjusts manufacturer's schedules to fit.

But DEPA is not a claimant agency for such projects. Each industry and institution, even if it feels it has an urgent project, may not get what it wants without a claimant agency.

There are a number of these, in addition to DEPA, which act only for the power utilities. Some are: Defense Solid Fuels Administration; Defense Minerals Administration; Economic Cooperation Administration; Veterans Administration; Department of Agriculture; Defense Transport Administration; and a number of others.

If the project is for an industry like paper, chemicals or some field not covered by the regular claimant agencies, it still has NPA itself for a claimant agency, through the NPA Industry Divisions.

These include divisions on such things as electrical equipment, engines and turbines (including boilers, internal combustion engines, generators, motors, etc; leather; lumber; pulp and paper; rubber; railroad equipment; textiles and many others.

How to Get Ratings on Industrial Power Equipment

The industrial or institutional power engineer should first analyze his complete project, including both A and B products, schedule delivery and erection, work out all details and present it to the appropriate NPA industry division.

The power engineer must justify all this on paper to NPA. He must convince not his own management but men who will judge his proposal solely on the basis of national interest or relation to defense efforts first.

If in any doubt, the engineer will find one of the field offices of the U. S. Department of Commerce somewhere near him, which can give him full information on every detail of procedure, required forms and so on. Suppliers of equipment and their representatives also know how most of these details can be handled.

Special arrangements can be made for replacements, small jobs, maintenance, repair and operating supplies.

Avoid going to Washington if possible — you'll get more detailed help from your local NPA field office.

If you have any trouble finding the nearest one, which may be in a relatively small city near you, either write the Editor of POWER ENGINEERING or write direct to the U. S. Department of Commerce, National Production Authority, Washington 25, D. C.

Electrical Progress—Ten Billion

The tremendous scope of the electric art covers developments ranging from circuit breakers with interrupting capacities of over ten billion kva to junction transistors operating with a power of six tenths of a millionth of one watt. The latter is what Louis Ridenour calls lazy flea power

By ANDREW W. KRAMER

Editor, Power Engineering

DEVELOPMENTS in the electrical art are so diverse, so numerous, and cover a range of applications so tremendous, that an appraisal of progress in this field involves practically every aspect of modern civilization. Recent achievements, for example, include such different items as new methods of cooling large electric generators, the construction of a clock that varies less than a second in 30 years, a submarine telephone cable with submerged amplifiers, a method of controlling the flow of anesthetics to patients on the operating table by means of feedback from the patient's own brain waves, an ultra high frequency transcontinental radio relay system, a vapor-cooled transformer, and, perhaps the most startling of all — an electrified bed with a built in television set! Cost of the latter, one thousand dollars.

Of course, the real measure of progress in the electrical industry is the installed generating capacity of this country, and its output. From 13 million kilowatts in 1920, this installed capacity has increased to 75 million kilowatts at present. By 1961 it is expected to reach 140 million kilowatts with an annual rate of generation of over 600 billion kwh. Thus, in ten years the amount of equipment for the generation, transmission and utilization will almost double, provided we can get the physical material to effect such an enormous increase. The history of power development over the past 50 years shows that the installed capacity has been doubling about every ten years. Whether this rate of growth can be maintained in the face of steadily dwindling sources of material, and vastly increased need of material for other purposes, remains to be seen.

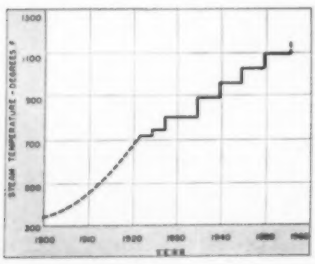


Fig. 1. Increase in 3600 rpm generator ratings

In an address at Portland, Oregon, last summer, Dean G. W. Gleeson of the School of Engineering at Oregon State College, predicted that by the year 2000, the consumption of energy in the United States will be about 18 *trillion* kilowatthours annually — just about the consumption of the entire world today! This is only 50 years from now. Where is this power coming from — coal, oil, atomic energy, wind, water, solar energy?

Our Fuel Outlook

With the exception of hydro-electric power, our energy now comes from discontinuous sources, the fuels which are finite in amount. Although there are ample and available sources of energy to provide for our immediate requirements, the cream has already been consumed, and within the next century, the fuel situation as we now know it will not exist. The coal and oil fuel resources, both organic, were laid down over a period of many millions of years but we are exhausting them in a matter of a few hundred years. What will we use for fuel after they are gone? Atomic energy? Curiously enough, atomic energy is the only source in the discontinuous category which does not depend upon fossil fuel, and accordingly uses the only fuel which is inorganic. But even energy produced by nuclear fission depends upon fissionable material, and this, like other fuels, is limited in amount.

At the present time, however, materials such as copper, manganese, steel, and aluminum are of greater concern to us in the electrical industry than fuel, though the production of aluminum is directly related to power. As a consequence of increasing scarcity of strategic materials, the design of electrical machinery has tended towards a more effective use of materials. In electric generator and transformer design for example, improved cooling methods have materially decreased the amounts of copper and steel required for a given rating. Indeed, among the outstanding developments of the year were the new methods devised by Westinghouse and Allis Chalmers for cooling large electric generators. Westinghouse, as described in detail in the November issue, developed a method of generator construction using hollow conductors through which hydrogen is circulated. This method will increase large generator ratings by one half, and makes possible generating units with ratings as high as 200,000 kw, perhaps even higher. The Allis-Chalmers method employs a two-stage compressor as an integral part of the rotor, delivering compressed hydrogen directly to the surfaces of the rotor conductors. Thus high-velocity hydrogen sweeps the surface of the rotor conductors, resulting in a rapid transmission of heat from the conductors to the hydrogen. The method has been called the *supercharged* method of cooling, and for a given length of rotor an output 70 per cent greater is obtained.

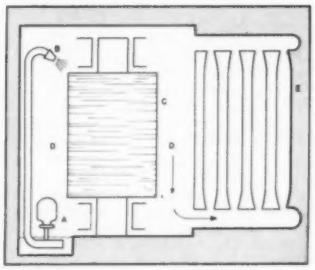


Fig. 2. Schematic diagram of the Vaporization Cooled Transformer

It is through improvements of this nature that the industry is making plans to build generators of considerably greater capacity than those now in service, though even now, single-shaft machines as large as 185,000 kw are being installed. With the exception of the low-pressure

Kva to Lazy Flea Power

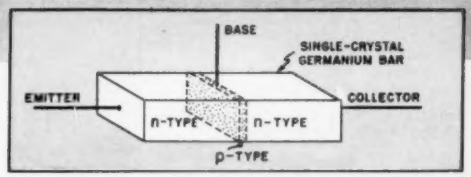


Fig. 3. The junction transistor is as simple as a brick—a small brick, that is

units of cross-compound machines, all the recent large generating units are 3600 rpm machines. The size of 3600 rpm machines has doubled since World War II. It is predicted that 250,000-kw machines will be available within the next few years, and possibly 300,000-kw machines within the next ten years. Figure 1 shows the increase in 3600 rpm generator ratings over the years. The larger rated units of the future will have still less weight per kilowatt of capacity, and will either operate at higher temperatures or have still different cooling systems, or both.

Turbines Above 3600 RPM?

The steam turbine is inherently a high speed machine, and a future possibility is that geared turbines may be used with several small, high temperature turbine wheels operating in parallel at speeds higher than 3600 rpm but with the generator running at 3600 rpm.

With respect to the use of higher generator voltages, the opinion of American engineers seems to be that there is an optimum voltage for each size machine. As generating units become larger, it becomes desirable to increase the generator voltage, but there seems to be no need of doubling or tripling present generator voltages as foreseen by Irving Moultrop at the AIEE Winter meeting last year. We have had at least one machine operating at 22,000 v in this country for a number of years, but so far, we have never gone to the 33 kv used widely in England. So far, the highest voltage considered for machines in the U. S. is 27 kv.

There is one aspect to the problem of generator voltage that is of interest and that is, that the question of higher generator voltage is not so much a problem of generator design as it is of generator connections and of terminal bushings. The main generator leads of very large generators, from the machine to the step-up transformers, are very massive and costly where low voltages are used. By going to a higher voltage the amount of copper in these connecting leads could be greatly reduced. The same holds for the size of terminal bushings; in large size generators these are now so large that unless higher voltages are used in future generators, they will constitute a limiting factor with respect to size of machines.

In transformer design, as in generator design, the trend is towards greater efficiency, less weight, better insulation, and better cooling. At present manufacturers are building 190,000 kva, 3-phase, water-cooled transformers for 138 kv service which can be shipped in one piece.

Vapor-Cooled Transformer

In the smaller sizes of transformers an interesting development last year was the preliminary design by Westinghouse, of a vapor-cooled unit. A diagram of this transformer is shown in Fig. 2. A small pump A forces liquid fluorocarbon to a spray nozzle B. The liquid falling on the transformer coils evaporates, taking the latent heat of vaporization from the coils. The vapor fills the tank D, insulating the transformer parts. The vapor is forced upward through the cooling tubes E, and as it condenses the condensate flows by gravity back to the sump. Condensation is accompanied by a small change in the temperature and the temperature of the cooling surfaces is only a few deg C lower than that of the coils. It is expected that the voltage ratings of such transformers can be extended far beyond the present 15-kv ceiling for dry-type transformers. Heat transfer is far superior to that with circulating oil; therefore a much more compact coil assembly can be made and the external surfaces reduced.

Switchgear manages to keep up with power concentrations but the latter are increasing at a rate to continually challenge switchgear designers. Circuit breakers with ratings of 10 million kva interrupting capacity are now installed at the Grand Coulee switchyard and during the summer of 1950 a series of tests were carried out there to verify the interrupting capacity of these oil circuit breakers.

In March of last year another test was made at Grand Coulee of a 220 kv Brown-Boveri *airblast* breaker. This breaker proved that it was capable of interrupting in 2½ cycles, faults up to 11 million kva, 3-phase equivalent. This is a value never before approached by air circuit breakers.

High speed-breakers together with high-speed relays have contributed more to the stability of interconnected power systems than any other factors. Today, our best high-voltage transmission line relays will operate in from 1 to 3 cycles with the fastest circuit breakers guaranteed for 3 cycles.

Transmission voltages in this country have not gone above the 267 kv used on the Hoover Dam lines but, as a result of the high-voltage tests made in recent years, the American Gas & Electric Co is planning an extra high voltage transmission system to operate at from 300 to 315 kv.

As transmission lines become more expensive the problem of conductor vibration becomes of increasing importance. Last year, plans were made to install 18,000 Stockbridge dampers on the first two Hoover Dam-Los Angeles transmission circuits. Initially, about 10 per cent of the line had been equipped with dampers but not until late in 1949 was any trouble experienced due to vibration. Soon several other breaks were located and a complete inspection of the line resulted in the startling discovery that vibration was being experienced far in excess of any ever measured in the earlier years. So, a 180-ft length of the Type HH conductor was removed from the line at one of the vibrating points. It was found that much less energy was required to vibrate the cable after its 15 years in service than when it was new. By oiling the cable so that oil lubricated the dovetail joints of the conductor, a condition was produced wherein the required energy to produce vibrations was greater than that required when new. Hence, it was deduced that the increased friction between the sections of the conductor

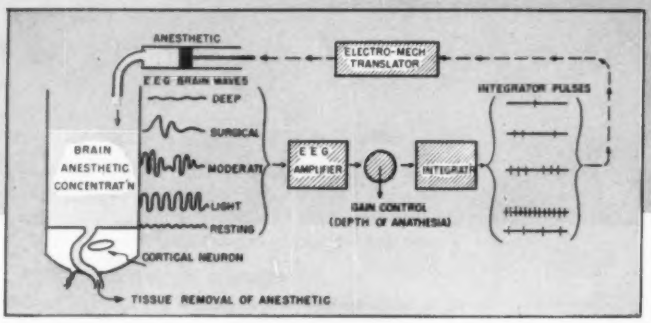


Fig. 4. Schematic representation of the brain wave controlled servoloop used in the control of anesthesia

became so large after 15 years that sliding was no longer present.

Electronics

Developments in electronics are so numerous and of so varied a nature that here we can only consider the art in its broadest aspects. In a sense, electronics can no longer be regarded as a separate branch of the electrical art since it permeates every element of the field of electrical engineering.

Despite its great importance, however, the electron tube has certain disadvantages; indeed, writing in the *Scientific American* last August, L. N. Ridenour concluded that there was nothing wrong with electronics that the elimination of vacuum tubes would not fix! Heresy perhaps, but it focuses attention on the capabilities and limitations of vacuum tubes. What are these limitations? Well, electron tubes consume power inefficiently (heater power in particular). They have limited and unpredictable life, and they are fragile. However, since we had no alternative, and since they could do things no other device could do, we put up with them. In 1948, however, a new device came along which seemed to be able to do certain things the electron tube could do. This was the transistor. It was efficient, needed no heater power, seemed to have long, perhaps indefinite life, and it was small. But it was noisy, fragile, expensive and difficult to apply. As a result, most electronic specialists were complacent.

The Junction Transistor

The principle involved in the operation of the transistor was too basic and too unique, to remain in only a partially developed state and last year a further step was announced by members of the Bell Telephone Laboratories, the *junction transistor*. As described in the November issue of *Electronics*, the junction transistor is enormously more efficient than a vacuum tube, is not noisy, is rugged as all outdoors, and is easy to engineer into a circuit. It is still expensive but history shows that as devices are developed the cost decreases. As shown in Fig. 3 it is as simple as a brick.

So, for the first time in 50 years, the electron tube has a real rival, one with sharp spurs and a disposition to take over. It promises to establish whole new areas of electronic engineering from computers to telephone switching circuits. These junction transistors are still small and their power capacity low but there appears to be no fundamental reason why the power levels cannot be raised. Indeed, even now, a broadcast band radio receiver with normal sensitivity and power output can be built completely without vacuum tubes. One junction transistor, operating in an audio oscillator circuit, will oscillate stably with a power supply of 6 microamperes at 0.1 volt, or 0.6 microwatt. This is less than one millionth of the power required for the filament heater alone in a conventional receiver tube, and is, in fact, less power than that developed by a flea jumping once every 8 seconds. Ridenour calls this not flea power, but lazy flea power.

The junction transistor will almost certainly displace vacuum tubes in innumerable low power circuits. What about high power? Whether the transistor principle will enter the realm of high power cannot be predicted today, but for high power applications a device has come into prominence in recent years which also competes with the electron tube. This is the magnetic amplifier. Now, the magnetic amplifier is not new; it was performing power amplifying functions when vacuum tubes were in their infancy. Now, however, the availability of better core materials and dry type rectifiers makes possible greater flexibility of performance, and higher amplification.

In concluding this very sketchy survey of the electrical art let me describe, briefly, just one example of the application of electronics in the field of electrical control. This has to do with the administration of anesthesia to patients on the operating table. This, of course, is essentially a problem of regulation. The anesthetist receives a continuous flow of information from his (or her) sense organs, which, in the light of previous experience, he utilizes to form a judgment of the patient's depth of anesthesia. In accordance with this judgment, he manually increases or decreases the anesthetic concentration. The system is an error-actuated type of servomechanism with continuous feedback of information from the patient to anesthetist. Like any humanly regulated action, the system is subject to defects, caused by errors in judgment, improper timing, discontinuities in flow of information, etc.

Utilizing Brain Waves

With a view of improving this condition, at the Mayo Clinic there has been developed an electronic system of regulation in which the flow of anesthesia to the patient is controlled by the electrical activity of the patient's brain through the use of the electroencephalograph. This brain activity consists of low frequency (2 to 30 cycles) electric waves whose potential varies from 100 to 500 microvolts. These waves are conducted to the surface of the head and can be recorded from metallic contacts on the scalp after suitable amplification. When an anesthetic is given to a person, after an initial increase, the electrical output of the brain decreases as the depth of anesthesia increases, and in deep anesthesia all electrical activity disappears. Thus, it becomes possible, by means of suitable electronic integrators and amplifiers, to automatically regulate the flow of anesthetic in accordance with the depth of anesthesia to maintain the latter at the correct level. When this system was first tried out, it was subject to electrical interference from the movement of static charges in relation to the head, or to 60-cycle induction from the power mains. Further study disclosed the fact that all the information for anesthetic control was contained in a band of frequencies between 6 and 10 cycles per second. Accordingly a phase-shift network was devised which filtered out everything but this narrow band of frequencies. When this was incorporated into the servoloop the system was found to give excellent results with no trouble due to interference. To just what extent this relatively simple servomechanism will replace the human linkage type in practical anesthesia remains to be seen, but there is no question of its value in the experimental field, where the control of anesthesia level in animals over long periods is extremely important.

Ralph Emerson Turner

RALPH E. TURNER, former Editor of Power Engineering, died after a short illness on November 26, at his home in Western Springs, Ill. Although Ralph had retired from active service in 1948, he retained a keen interest in Company activities and often came to visit us. He suffered a slight heart attack some 2½ years ago and had been under doctor's orders not to exert himself, still he had recovered to a point where he frequently came downtown to chat with his former colleagues. His somewhat sudden death, therefore, came to us as a shock; only a few months ago, he dropped in on his way to attend a dinner meeting of the Chicago Section of the ASME of which he was a life member.

Ralph Turner was one of the older members of the Technical Publishing Company organization, having started in 1908 as Associate Editor of the Practical Engineer, which was the name of the magazine before it was changed to Power Plant Engineering in 1918. Ralph had come from Nebraska. He was born in Columbus, Nebraska on March 9, 1879. His father, Moses Kennedy Turner, was the editor and publisher of the local Columbus newspaper, so Ralph's indoctrination into editorial techniques began at an early age. Newspaper work evidently was not his forte because, after graduation from the Columbus high school, he enrolled as an engineering student at the University of Nebraska, from which he was graduated in 1906 with the degree of B.S. in E.E. During the first two years of his college career he worked, spare time, with his father as business manager of the Columbus Journal.

Following graduation, he went to Pittsburgh to enter the employ of the Westinghouse Electric and Manufacturing Co as student apprentice in 1906, and a year later, became an erecting engineer for that company. In October 1908 he left Westinghouse to move to Chicago and become Associate Editor of the Practical Engineer. This was the beginning of what was to be a long and interesting editorial career. For 40 years, first as Associate Editor, then as Managing Editor, and finally as Editor, Ralph Turner was a major force in shaping the editorial character of Power Plant Engineering. For many of the early years, in fact, Ralph Turner, together with Arthur L. Rice, the Editor, constituted the entire editorial staff.

In 1911 Ralph was married to Hulda Victoria Malm, who together with four sons, survives him. Shortly after their marriage, the Turners built their home in Western Springs and lived there ever since. Ralph Turner was a warm hearted, good natured, likable person and it was inevitable that he should take a great interest in the social and civic life of the village. Through the years he gave his effort to many local activities. He was a member of the school board, served as Village Clerk and was active in church work. In his younger days he had an excellent voice and derived much pleasure from solo and quartet singing. At one time he was a member of the Apollo Quartet. With four boys of his own he was interested in young people's activities in Western Springs and for many years was active in Boy Scout work.

Professionally, he was active in a number of engineering organizations. He was a life member of the ASME, having joined the Society in 1915, and besides serving on various committees, he was Chairman of the Chicago Section of the ASME in 1938–39. He was also a life member of the Western Society of Engineers, having joined that organization in 1920, and he had been an associate member of the National Association of Power Engineers since 1908. For the year 1943 he served as Secretary-treasurer of the Illinois Engineering Council, and from 1943 to 44 he was Western Vice President of the National Conference of Business Paper Editors. Finally, he was a Registered Professional Engineer in the State of Illinois.

Ralph retired from active service with Technical Publishing Company, of which he was a director, in 1948 to become Editorial Advisor. His impaired health prevented him from devoting much time to company affairs since his retirement but he retained a deep personal interest in the magazine which was so much a part of his life until the very end. We shall miss his pleasant, happy personality.

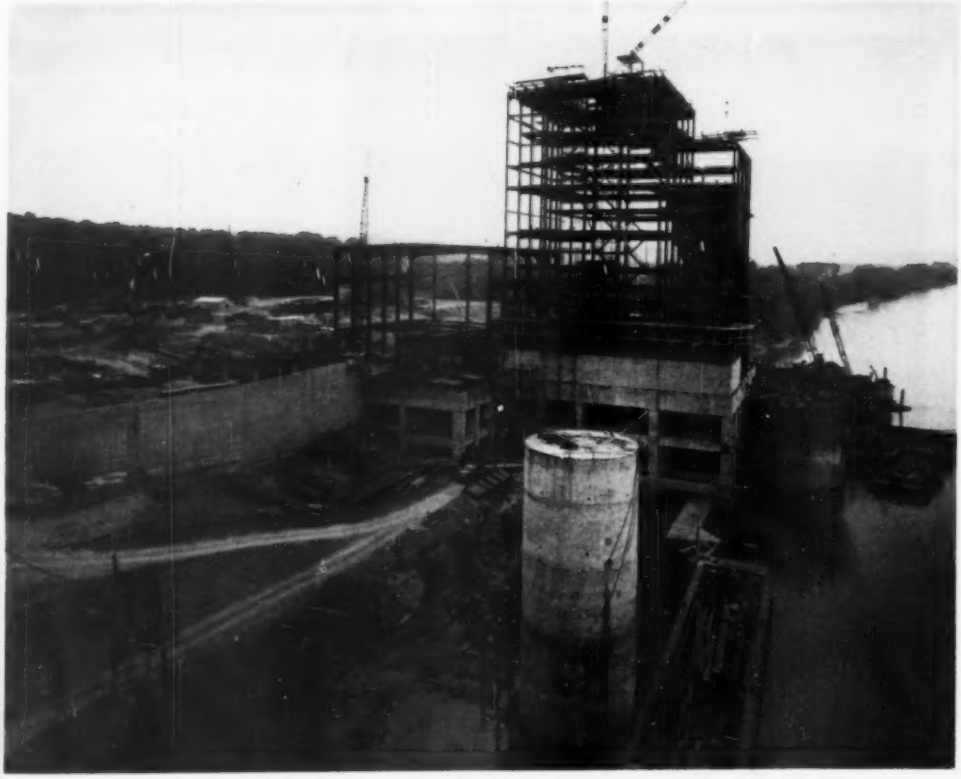


Fig. 1. General view of Walter C. Beckjord Station on July 27, 1951. Left to right:—retaining wall, turbine room, boiler house, crib house; conveyor pier in foreground

Walter C. Beckjord Station Built From Ohio River—No Railroad

BY H. B. McDERMID

New, third generating station of Cincinnati Gas & Electric Co. rises on bank of Ohio River near New Richmond, Ohio, 18 miles up-river from Cincinnati . . . Unique feature is lack of direct rail connection; all heavy equipment handled into plant from river barges by 200-ton crane, one of largest cranes on inland waterways . . . New station design: one pulverized coal-fired boiler per turbine generator; steam conditions 1450 psi, 1000 F, reheat to 1000 F . . . First unit 100,000 kw scheduled for April, 1952; second 100,000-kw unit authorized before plans completed; third 125,000-kw unit authorized as first unit construction started; plant can be expanded to 6 or 8 units . . . Why cranes and river transport were cheaper than building rail spur . . . Provisions for flood protection and access

THE CINCINNATI Gas & Electric Company is at present building a third power plant, which will supplement the generating facilities of its two existing plants. All three of the plants are situated on the Ohio bank of the Ohio River — Miami Fort Station being about 20 miles down river from the center of Cincinnati, West End Station about a half mile down river and the new Walter C. Beckjord Station (formerly called Clermont Station *) 18 miles up the river near New Richmond, Ohio.

All three plants are subject to the danger of severe floods, for the flood plain of the Ohio in this section is very narrow, so that floods cannot spread very far horizontally. The two present plants, when built, were protected against any floods which seemed likely to occur; but in 1937 the record Ohio River flood with an 80-ft stage (i.e. rise of 68 ft from pool stage), drowned out both stations for over a week.

Flood Protection

These stations have since been given protection against a 71-ft rise above pool stage and the new plant has been built to operate without in-

terruption with a 73-ft river rise. The area adjacent to the plant has been filled to a grade well above usual floods and is protected along the river bank by the plant and by a partial retaining wall.

The plant is at present accessible only from a state highway, which is cut by high floods. However, from the filled area, a causeway, a bridge over the state highway and a road up the hills at the edge of the river's flood plain will be built to connect with a road at the top of the hills. This new route will give easy access to the plant during floods without resorting to the use of army surplus "ducks," which have been pressed into service in the past at West End Station.

Coal and Heavy Equipment by Barge—No Rail Connection

A unique feature of the station is its lack of a direct railroad connection. It will be served only by river and highway transportation, necessitating coal and heavy equipment delivery by barge. Both the older plants receive coal by barge, so the design of the coal unloading equipment at the new station presented no new problems.

Coal is to be unloaded at a coal unloading tower and either crushed and delivered by belt conveyor to the coal bunkers above the coal pulverizers, or delivered uncrushed by belt conveyor and wagon scraper to the storage area, there to be held until needed and then reclaimed by scraper and conveyor.

Delivery of heavy equipment, however, presented a very definite problem. The plant site is about 13 miles from the nearest available railroad over unfavorable terrain, and a rail spur was estimated to cost between $3,000,000 and $5,000,000. The purchase of the necessary equipment-handling cranes, one at the new station and one at a suitable railhead on the river, was found to be only $750,000.

Powerful Cranes Installed

Result of these studies was the erection of the two most powerful cranes operating on the inland waterways of America. Each has a capacity of over 200 tons (the capacity being determined by the weight of the generator stator). One is located at Miami Fort Station where there is rail service, and the other at the Walter C. Beckjord Station. Thus heavy equipment comes in at Miami Fort by rail and is trans-shipped up river by barge to the Walter C. Beckjord Station.

Figure 2 shows the 98-ton Unit No. 1 boiler drum being unloaded from a special equipment barge at the new station site.

Steam Conditions

The boilers will generate steam at 1450 psi at a temperature of 1000 F. with reheat to 1000 F. It is predicted that the over-all station heat rate will be 9860 Btu per kwh.

Fig. 2. Unloading 98-ton boiler steam drum from equipment barge for Unit No. 1, Walter C. Beckjord Station. Crane of 200-ton capacity (determined by weight of generator rotors), one of largest inland, specially built for construction of plant. Photo June 14, 1951

Each unit consists of one pulverized-coal-fired boiler and one 3600-rpm turbine-generator.

The stacks serving each boiler will be 18 ft in diameter and 162 ft above the boiler room roof line. Despite the fact that the station is several miles from New Richmond, electrostatic precipitators are to be installed, which will hold the discharge of smoke and fly ash from these stacks to a minimum.

Ash will be carried from beneath the dry-bottom furnaces by hydraulic conveyor and delivered to a large pit left in the fill. The pit covers several acres and is expected to take care of the ash disposal problem for some years to come.

Plant Design Expanded Rapidly

Expansion of the plant is typical of the times. When the plant was under early discussion, it was decided to put in one complete unit of 80,000 kw capacity. Preliminary sketches were not complete before this was boosted to 100,000 kw. Before plans were complete for this unit, a second unit of 100,000 kw was authorized; and, as construction was starting on the first unit, it was decided to construct a third unit of 125,000 kw capacity, for a total of 325,000 kw at a total cost of approximately $50,000,000. The plant site has ample room for expansion of the plant to six or eight units. Consulting engineers are Sargent & Lundy of Chicago.

The major units of equipment were purchased from several manufacturers. The first unit will have a Combustion Engineering boiler, a Westinghouse turbine generator and an Allis-Chalmers condenser. Unit No. 2 will have a Combustion boiler, a General Electric turbine generator and a Westinghouse condenser. Unit No. 3 will have a Babcock and Wilcox boiler, a General Electric turbine generator and a Worthington condenser.

It is expected that Unit No. 1 will go on the line in April of 1952, Unit No 2 in June of 1953 and Unit No. 3 in December of 1954.

* By action of the board of directors of Cincinnati Gas & Electric Co., on September 25, 1951, the name of Clermont Station was changed to Walter C. Beckjord Station in honor of the company's president.

Design of Pipe Hangers for High-Pressure Systems

The design of modern high-pressure piping systems demands careful consideration of the methods used to support the piping. Unless the location and nature of the pipe hangers needed are accurately determined beforehand, costly revisions and alterations may become necessary. In this article Mr. de Soto outlines the general procedure that is to be followed in the design of a modern piping system.

By HENRY DE SOTO

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THE EXTENSIVE INCREASE in the use of high pressure, high temperature generating equipment during the past ten years have made designing engineers conscious of the importance of pipe hangers, especially for high pressure piping and the need for a more technical attitude toward this element of power plant design.

To attain the best design it is necessary that the question of pipe hangers be considered as an integral part of the piping system from the beginning. Quite often it is found that after the completion of piping layouts, hanging provisions have been either lightly considered or totally disregarded, resulting in the sad realization that at a too-late stage of progress, expensive additional steel supports have to be provided. The only way to avoid such unnecessary changes is to coordinate the design of the building structure and large size piping so that hanging arrangements can be included in the original design. This, however, is not a simple matter. The proper coordination of the three phases of a project — structure, piping, and pipe support — often entails tedious duplicate layout work and a great deal of concentrated study.

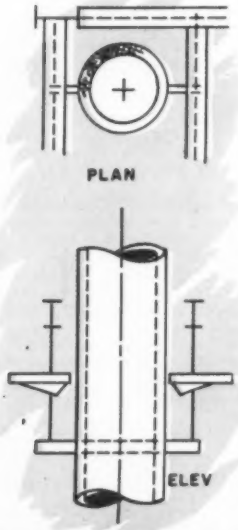

Fig. 1. Locating a vertical pipe riser too close to a structural member is not advisable

As evident from Fig. 1, locating a vertical pipe riser too close to a structural steel column is not advisable without first having calculated the pipe load the hanger must support and the movements of the pipe for which the hanger must provide.

Design engineers familiar with the techniques of good piping and hanging will accept the following steps as desirable.

The piping layout should follow in the horizontal course provided or conveniently found floor or bracing structural steel members. The vertical pipe risers should be located at a safely estimated distance from steel columns bearing in mind constant supports which presently trend towards a wide and long, flat design. This type of hangers is the one generally accepted for the high loads and excessive temperature movements modern high plants demand.

The thickness of pipe required being known approximately, the next step is to calculate the weight per foot. The weight is the total weight of the pipe, the fluid it is to carry and the insulation. Fittings and valves must be calculated separately.

Having arrived at a unit weight for each size of pipe in the system, the next step is to spot convenient hanger locations. In the horizontal runs, pipe clamps are usually fastened to pipe up to 14 in. diameter. Above 14-inch sizes, pipe trapezes, ears and lugs are used. These three methods, requiring a steel plate to be welded to the pipe, should be planned so as to make use of the pipe fabricator's facilities for steel relieving when welding, since they are of necessity of the same alloy as the pipe itself. Pipe clamps usually require one rod to the supporting steel member and pipe trapezes must have two or more rods to the supporting steel member or members. Fig. 2 is a method often employed for pipe trapezes.

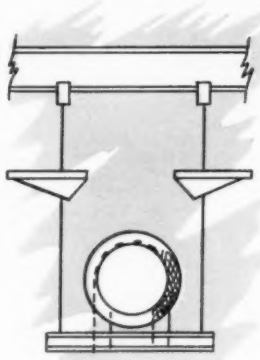

Fig. 2. Method often used in applying pipe trapezes

At the bottom of this page is a very practical hanger spacing table.

However, for the thicker than standard piping used in high pressure and temperature design the spacing shown in the table can be safely increased by 25 per cent.

As the strict requirements of boiler and turbine manufacturers demand the avoidance of undue stresses upon the connecting terminals, it becomes imperative to provide one or two

MAXIMUM SPACING BETWEEN PIPE SUPPORTS

NOMINAL PIPE SIZE	1	1½	2	2½	3	3½	4	5	6	8	10	12	14	16	18	20	24
MAXIMUM SPAN—Ft.	7	9	10	11	12	13	14	16	17	19	22	23	25	27	28	30	32

anchors at a point or points most effective. The piping engineer must provide the design engineer with such locations, or the design engineer must calculate and spot them conveniently.

Anchors may be of the rigid type which fastens the pipe through structural members to a part of the structure. This type holds the pipe secured at such point, that is, avoids its movement in any direction. See Fig. 3. The anchor could also be a stop for downward and upward movement only, enabling the vertical pipe to move freely east or west, north or south. See Fig. 4. This type usually consists of rod hangers. Again, the vertical pipe may move east or west, north or south sufficiently to necessitate a combination spring and rod support. This device allows no up or down movement and avoids, when the pipe tilts due to thermal expansion, one of the two rods from carrying an unbalanced load. See Fig. 5.

Related to the procedure of locating hangers and anchors is the also very important task of locating sway toggles and guides in the piping system. This part of the work is as important as each of the others. Sway toggles, intended to eliminate vibration of the expanding and contracting sections of the system, are often attached to the same clamp or trapeze provided for hangers and it is to the advantage of hanger manufacturers to be informed of their use. Guides, of course, as the name implies are meant to hold the pipe during its thermal movement usually in one direction but sometimes in two, yet, prevent the other movement. A very useful manner of guiding arrangement is as shown in Fig. 6.

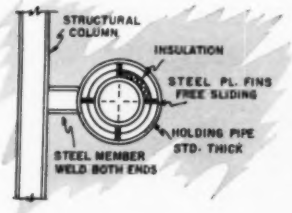

Fig. 6. A very useful guiding arrangement

Having already calculated the weight per linear foot of the different pipe sizes, fittings and valves, the next step is to figure accurately the weights of the sections of the system between hangers as roughly spotted. It is necessary to solve for different end reactions, using standard structural formulae for moments and forces. It is, however, very important to achieve accurate loads at each hanger. Very often when the load is too large or too low, or not conducive to a good layout, the designer is compelled to rearrange the hanger locations to gain a better balance and arrangement.

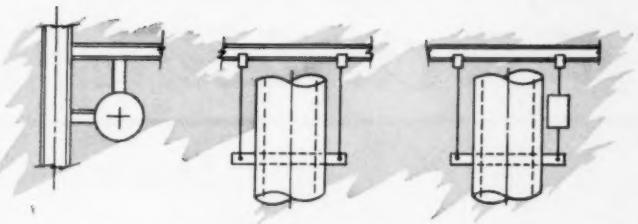

Fig. 3, 4 and 5. Three different methods of anchoring pipe

The next step is to calculate the movements of different runs of the piping system caused by its thermal expansion. Standard text books and piping catalogs and bulletins furnish the design engineer with reliable expansion constants which are used as multipliers per linear foot in any direction of the system from the anchor points. As stated before, the primary anchor points are the end connections and any other anchor or anchors provided to relieve undue stresses at these points as required by equipment manufacturers. To avoid excessive stresses often the well known practice of arranging for cold strains deductions in the run of the piping system affords much welcomed relief.

The work is already prepared for the next step, the selection of proper hangers to suit loads and movements. The supporting force at each pipe supporting point must be known and the total supporting forces must be equal to the calculated weights. The project engineer must assist the design engineer in this task since both must be satisfied of the choice of hanging equipment. Constant supports have gained much in their reliability and their choice is almost unanimous in major requirements. Three types of hangers are shown in Fig. 7. The type shown at A is a must. Next in range of choice is the type shown at B. Helical springs, shown at C, occupy less space, but are limited in their bounds of maximum movement often not enough in this day of high temperatures.

The center line elevations of the pipe clamps for hangers, or of the pipe where trapezes are required, must be given for the cold, designed position. This enables the hanger manufacturers to furnish beam clamps, rods, spring supports and other auxiliary attachments to fit properly. The elevations for different hangers in the same horizontal run of pipe will vary according to the drainage slope used which in many cases is dependent also on the upward or downward expansion of the vertical section or sections of the piping system.

Having selected the proper and suitable hangers for each support, it is advisable to work out a chart showing the hanger requirements and giving all hanger information for the benefit of the equipment manufacturers and for the convenience of the field erectors. A very useful chart called a Hanger Schedule is shown in the accompanying illustration.

These procedures, recommended by present design-engineering practice as leading to a satisfactory arrangement of hangers for modern high pressure, high temperature piping systems, if coupled with practical good judgement will furnish a reliable course for the ultimate attainment of a well engineered job.

HANGER SCHEDULE

HANGER NO.	NO. REQ.	TYPE	LOAD	ELEV'S. PIPE	SUPP. STEEL	MOVEMENTS					REMARKS SEE ST'L DWG.
						UP-DN.	N	S	E	W	
HS-1	2	CONSTANT	10,200	22.25'	8"WF17	8" UP	4"		2"		A-13050
HS-2	1	ROD	6,300	12.25'	12WF27	4" UP	2"		1"		A-13051
HS-3	1	HELICAL	4,100	2.50'	16WF36	3" DN.		1"		3"	A-13052
HS-4	2	CONSTANT	7,500	14.66'	10WF21	5" DN.		3/4"		1"	A-13053

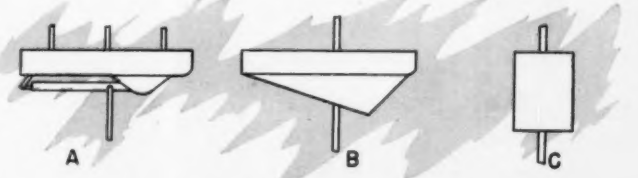

Fig. 7. Three different types of supports

Power Engineering NEWS REEL

Shows

U. S. Steel's New 60,000-kw Turbine Generator

Now in Operation—Largest Single-shaft Industrial Machine

LARGEST single-shaft turbine generator ever built for industrial power production is now in operation at United States Steel Co.'s South Works at South Chicago, Ill. Housed in a new ten-story addition to the No. 5 power station, the unit is one of the principal installations in a multi-million dollar improvement program at this United States Steel plant.

The new 60-cycle, 3-phase turbine generator is a condensing unit and generates 60,000 kw at 13,800 v, 0.85 pf. It has a direct-connected exciter and a generator hydrogen cooling system.

The turbine has five extraction points, the 15th-stage heater being a deaerating unit. Steam from a station service water-pump turbine and two turbine-driven boiler feed pumps exhausts into the deaerating heater. To maintain proper pressure in the deaerator at all times for sufficient reduction of oxygen in the boiler feed water, four pressure regulators are installed in extraction lines.

The 60-cycle 13,800-v electric power generated is transmitted to the Gary district plants of United States Steel. An underground duct system transmits the current to a 77,000 kva transformer in the outdoor sub-station where the voltage is stepped up to 69,000 v for transmission over two existing overhead circuits. These lines are controlled by selective pole-reclosing circuit breakers. A carrier current system is provided for relaying, telephone communication, and telemetering.

Normal station auxiliary power is supplied by a 5000/6260 kva, 13,800/-2300-v step-down transformer directly connected to the generator leads. The transformer supplies power to a 2300-v switchgear.

The switchgear is divided into two bus sections of six cubicles. Each bus section provides service for a 1500-hp induced-draft fan motor, a 300-hp forced-draft fan motor, and a 300-hp circulating water pump motor.

The generator, station auxiliary breakers, and the 69,000-v substation are controlled from switchboards in an extension to the central 22,000-v substation control house. Here also is located the load dispatcher and carrier current indoor equipment.

Liquid rheostats were installed for starting service and for speed control of the 2300-v, 1500-hp wound-rotor motors of the induced-draft fan. The rheostats function by varying the external resistance in the secondary windings of the motor through moving and stationary electrodes in an electrolyte solution. A regulating valve located in the cooling-water line to the heat exchanger maintains electrolyte solution at proper temperature.

An interlock between rheostat and fan motor starting circuit breaker prevents closing of the circuit breaker until the electrodes are in proper position and the electrolyte pump is running.

Steam for the turbine is provided by a

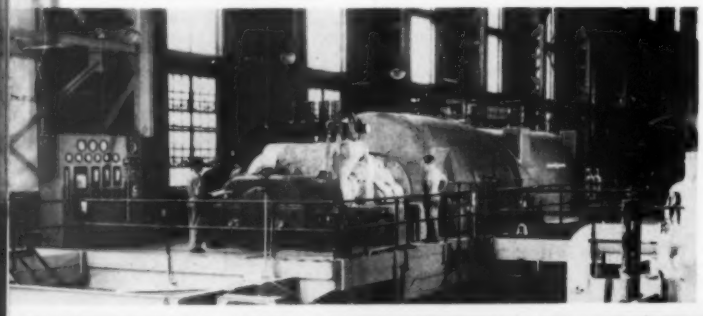

Fig. 1. (Left) General view of newly installed 60,000-kw single-shaft turbine generator and auxiliary equipment at U. S. Steel Co.'s South Chicago works.

Fig. 2. (Lower left) Roy Parmley, Gary, Ind. (left), and Carl Miller, Hammond, Ind., test instruments on automatic control board of 650,000-lb-per-hr boiler in multi-million dollar addition to No. 5 power station at U. S. Steel Co.'s South Chicago plant. Ted Nealt, 1706 Cornelia Avenue, reads meters in the background. Boiler is the largest ever designed to operate on blast furnace gas and will consume 140,000 cfm of gas at full load.

Fig. 3. (Lower right) Elmer Martz, of Orland Park, Ill. (left), makes report on operation of new 60,000 kw turbine generator at U. S. Steel Co.'s South Chicago plant while Eugene Jendral, 8444 Muskegon Avenue, checks control equipment.

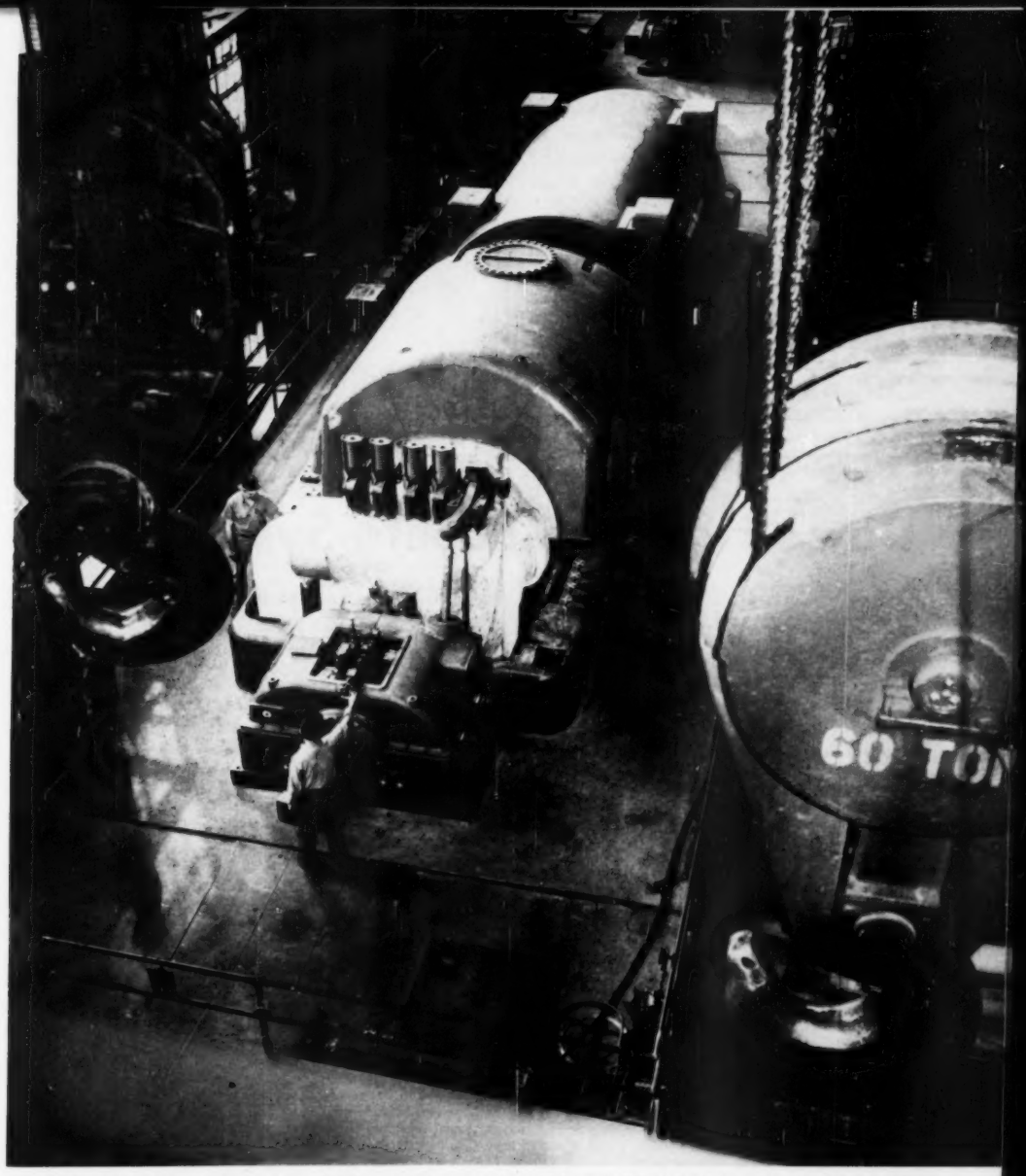

Fig. 4. Workmen check for signs of vibration in new 60,000-kw turbine generator during trial run at U. S. Steel's South Chicago plant. Reduction of vibration is one of the many steps taken during test period to ready generator for daily operation. Unit is largest of its kind ever built for industrial power production. It is housed in a new ten-story addition to the No. 5 power station

new boiler with a capacity of 650,000 lb per hr, at 900 psi, 900 F at the superheater outlet. This boiler is the largest ever installed to utilize blast furnace gas, an excess of which, at this plant, formerly had to be bled to the atmosphere.

The boiler is equipped with seven combination burners for utilizing blast furnace gas, natural gas, or fuel oil, two combination burners for natural gas or fuel oil, and is constructed for future installation of equipment for burning pulverized coal. The boiler is also provided with automatic combustion control, superheaters with superheat heat exchanger control, an economizer, tubular-type air preheaters, soot blowers with push-button control and hydro ash or soot removal.

With full load on the generator, the boiler will consume about 140,000 cfm of blast furnace gas, or the equivalent of output from three 900-ton-a-day blast furnaces.

To insure maximum availability of the new turbine generator until an additional boiler can be installed, the steam header has been cross-connected to the existing 450-psi steam system, which, in the case of an outage on the new boiler, will permit operating the new unit at 50 per cent of capacity.

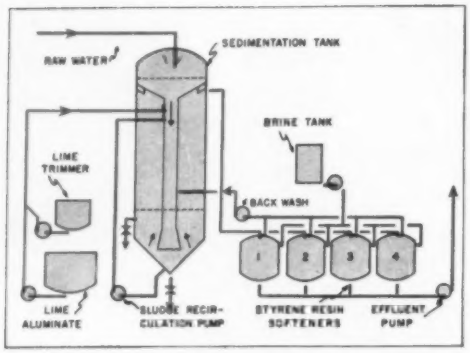

Fig. 1. Diagram of two-stage hot-process system, sedimentation plus ion-exchange, at Ludington plant of The Dow Chemical Co.

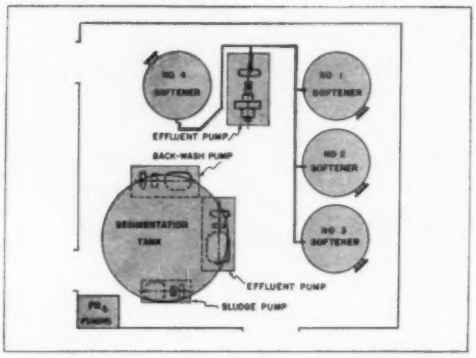

Fig. 2. Arrangement plan for equipment now used in Dow's hot-lime-zeolite system. Softener No. 4 added to increase capacity and give standby

Dow's Hot-Lime-Zeolite System After

EARLY HISTORY of the hot-lime-zeolite installation being reported on here was presented in detail at the annual meeting of the ASME in 1950 in Paper No. 50-A-77: — Power Plant Operation With the Hot-Lime-Zeolite Process. The purpose of the present report is to bring up to date the extent to which intentions of revision described in the previous paper have been carried out and the results experienced to date. These results were presented in this paper before the 12th Annual Water Conference at Pittsburgh on October 22, 1951, held under auspices of the Engineers' Society of Western Pennsylvania.

The original softener supplied approximately 25 per cent make-up water to two 225,000-lb-per-hr, 425-psig boilers. This softener unit was a two-stage, lime-soda-phosphate hot-process type, with three anthracite filters. The sedimentation tank contained the lime-soda and the phosphate compartments within a single shell. Several changes in the equipment were made after the hot-zeolite process had proved itself.

The phosphate compartment in the sedimentation tank was removed and the unit converted to a modified sludge bed type. A sludge recirculating pump was installed. Automatic sludge blowdown was added later. The filters were converted to softener-filters by the addition of brine laterals and surface washers.

Initial System and Operation

Operation of this plant began in 1943, treating make-up by the hot-lime-soda secondary-phosphate process. Operation was suspended for a few years following 1944; resumption of operation in 1948 demanded increased make-up to meet changes in process of chemical manufacture. By December, 1949, the hot-lime-soda secondary-zeolite system was placed in operation without disturbing the physical layout of the plant. Nalcite HCR was placed directly into the filters. The 48-in. side sheet limited the bed depth to 21-in. and the subfill to 10 in.

Initial operation proved that excessive turbidity coming from the primary softener required the zeolite units to be backwashed at too frequent intervals. This same experience was evidenced with the anthracite filters; however, the resin beds proved to be better filters, and pressure drop built up sooner than with the filters. In spite of the excessive sludge accumulations, no damage to the resin was evident and the resin spheres were always clean, with no adherent sludge. Sodium aluminate feed was started to the primary unit, which cleared up the turbidity. The remaining succession of instances involved revision of the primary softener to a sluge-type unit and the elimination of soda ash as a treatment chemical. This conversion did much to improve clarity and quality of water from the sedimentation tank. The primary softener could be operated with considerable flow variation without causing any alarming turbidity rise.

Getting More Capacity

By this time, operation without prefiltration looked to be feasible. Space was very limited and more treating capacity was needed, so it was decided to complete the installation by increasing the bed depth of the three units to 30 in. by extending the side sheet of the filters. A fourth filter-softener was installed to take care of outages and to increase the capacity of the softener. With the revising of the primary sedimentation tank and rebuilding of the zeolite softeners, an operating rate of 150,000 lb per hr is now possible, while maintaining a flow rate of 3 gpm per sq ft through the primary softener and three hot zeolite units. Previous design limited flow to less than 100,000 lb per hr through the primary softeners, although it was never established what this rate might have been if a coagulant had been used.

Boilers Clean for 2 Years with Hot-Lime-Zeolite Make-up

The steam generating units have been operating since December, 1949, on hot-lime-zeolite treated make-up. Analysis of the raw water and the treated supply averages as shown in Table I. The boilers have not been cleaned in over two years and inspection at the time of this writing shows the units to be in very good condition, with no adherent scale in the tubes inspected. Indication of the low amount of sludge forming salts entering these units can be seen in Fig. 4, which shows the overflow point of the feed trough to be exceptionally clean. Previous operation with the phosphate softener left this section of the boiler quite dirty from sludge deposits and required the boilers to be cleaned each 6-month period of operation.

Controlling the System

Since treatment chemicals fed to the primary softener are limited to lime and sodium aluminate, fed together, we felt very early that this unit could be operated by a pH recorder. This would eliminate the necessity for all but periodic testing of alkalinity conditions in the primary softener. Since only carbonate hardness and magnesium are being reduced, only the hydroxide excess is of importance. A pH controller and recorder has been installed and has operated quite well after some revision of the original installation. To accommodate such a controller, the abandoned phosphate tank is being

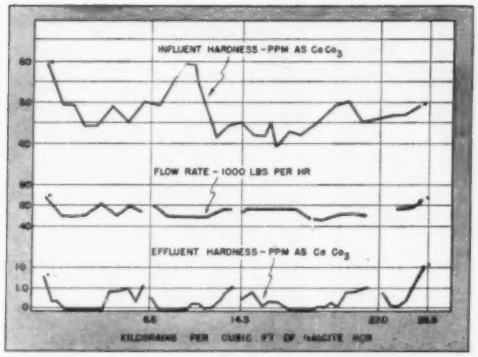
INFLUENT HARDNESS - PPM AS Ca Co3
FLOW RATE - 1000 LBS PER HR
EFFLUENT HARDNESS - PPM AS Ca Co3
KILOGRAINS PER CUBIC FT OF NALCITE HCR

Fig. 3. Cycle analysis of system of Fig. 1. Comparison of former process results with hot zeolite results given in Table I, evaluation in Table II

Proof of pudding is in eating thereof, especially in boiler feedwater treatment. . . . Here's data on 18 months of experience with hot-lime-zeolite water treatment system at The Dow Chemical Co's. Ludington, Mich. plant. . . . Since December, 1949, two 225,000-lb-per-hr, 425-psig boilers have been operating on make-up from that system. . . . Boilers have not been cleaned for 2 years, inspection shows them clean now. . . . Before hot-lime-zeolite, boilers needed cleaning every 6 months. . . . Chemical cost now 2.6 cents per 1,000 gal. . . . System was described a year ago in an ASME paper. . . . This article gives details of its performance, control of turbidity, how capacity was increased from 100,000 to 150,000 lb per hr, how it is controlled, cycle analysis, cleanliness of filters, operation without prefiltration; and costs

18 Months

By WILLIAM S. BUTLER
Power Superintendent,
Ludington Division,
The Dow Chemical Co.

utilized as a lime trimmer tank, the lime feed from this tank only, being operated by the pH controller. This batch is only 5 per cent of the concentration of the regular lime batch. This may not be the optimum concentration.

It happens that the desired control point of 10.1 pH can be maintained with a plus or minus 0.1 pH with only a slight change in the hydrate alkalinity. A 24-hr pH record is shown in Fig. 5. This range is maintained with only a very few checks by an operator, and this during the day shift only. The controller is being further modified to tell the operator when the range of the trimmer feed has been reached so that adjustment of the regular feed timer can be made. Further co-ordination of factors such as flow meter integration of treatment and sampling location should improve this control. At present, it works at high flow rates. At low rates, the lag in process must be considered, for the flow meter integrating the chemical treatment is not a variable type.

In order to complete the control of primary softener operation, desludging is being carried out automatically at intervals according to the quantity of water being fed to the softener.

The deeper resin beds have produced better quality water. The 30-in. resin beds produce a lower residual hardness than the 21-in. beds. Hardness values of less than 0.5 ppm as $CaCO_3$ are more readily realized. In addition, the deeper beds are more efficient for, at the 10-lb salt dosage, capacities ranged near 27,000 grains per cu ft. The capacity of the shallower beds was about 25,000 grains per cu ft as $CaCO_3$. Due to the added exchange capacity with the 30-in. beds of Nalcite HCR, a greater quantity of water is handled between regenerations. Suspended matter accumulates on the exchanger beds, since no prefiltration of the primary hot softener effluent is used. This requires periodic back washing between regenerations.

Table I. Average composition of raw water and treated water during cycle plotted in Fig. 3

Composition		Parts per Million (PPM)		
		Raw Water	Hot Lime Aluminate Softener Effluent	Hot Zeolite Resin Ion Exchanger Effluent
Total Hardness	as $CaCO_3$	180	50	0.5
Calcium Hardness	as $CaCO_3$	110	43	0.4
Magnesium Hardness	as $CaCO_3$	70	7	0.1
Phenolphthalein Alkalinity	as $CaCO_3$	...	16	18
Methyl Orange Alkalinity	as $CaCO_3$	144	30	34
Hydroxide Alkalinity	as $CaCO_3$	...	2	2.0
Phosphate	as PO_4	...	...	...
Silica	as SiO_2	3	0.6	0.5
Carbon Dioxide	as CO_2	...	...	...
Dissolved Solids		280	98	98
Turbidity	as SiO_2	3	0.7	0.3
Alumina	as Al_2O_3	Tr.	Tr.	Tr.
pH		8.2	10.3	10.3

Table II. Regeneration and operating capacity of hot styrene ion exchanger for cycle plotted in Fig. 3

Cubic feet styrene resin	83
Pounds sodium chloride	830
Pounds regenerant per cubic foot resin	10
Sodium Chloride to cation exchanger—%	20
Maximum concentration regenerant effluent—%	12
Brine contact period—minutes	40
Gallons water treated	760,000
Grains hardness removed—composite analysis	2,219,200
Operating capacity—grains per cu ft as $CaCO_3$	26,750
Operating efficiency—pounds per kilograin	0.37
Operating rate of flow range—gpm per sq ft	3.3

Table III. Laboratory evaluation of Nalcite HCR after 18 months at 220–234 F

Softener No.	Salt Dosage at 10% NaCl	Bed Depth, Inches	Capacity Igr per Cu Ft as $CaCO_3$
3	10 lb per cu ft	22.5	28.5
4	10 lb per cu ft	29.5	29.5

Table IV. Chemical cost with hot-lime-zeolite

Reagent	Cost per lb	Lb per M Gal	Cost per M Gal
Lime	0.9¢	1.14	1.025¢
Aluminate	10.2¢	0.107	0.109¢
Salt	0.82¢	1.14	0.920¢
Phosphate	10.25¢	0.051	0.520¢*
			2.57¢

* Note:—Some phosphate is consumed in treatment of small amounts of condensate contamination.

Softener Performance

The zeolite softeners perform best when operated at flow rates of 3 gpm per sq ft or more. At low flow rates of 1 gpm per sq ft, water follows the path of least resistance and causes exhaustion of portions of the bed,

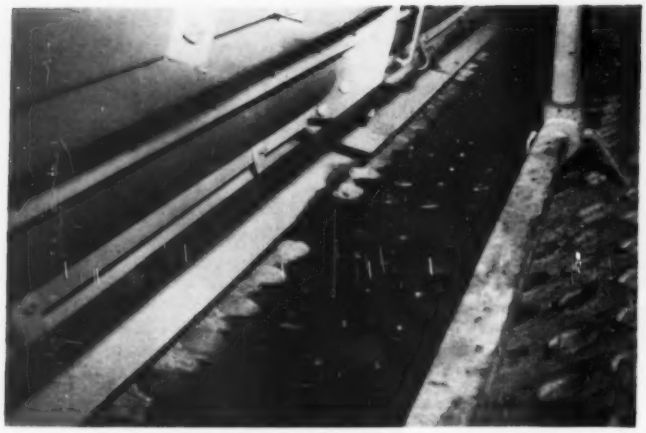

Fig. 4. View of overflow point of feed trough in boiler drum shows boiler exceptionally clean after 18 months on hot-lime;zeolite make-up

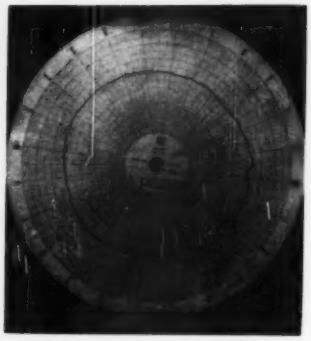

Fig. 5. Chart from pH recorder showing how closely desired pH value can be maintained

with unpredicted break-through of hardness.

A cycle analysis is shown in Fig. 3 and evaluated in Table II. Experience has shown that with an influent turbidity averaging 1.0 ppm, approximately 5,000–5,500 gal per sq ft can be treated between backwashings. This is quite consistent if the flow is kept up. For example, in the cycle plotted in Fig. 3, the three backwashings followed the treatment of practically identical quantities of water.

Internal condition of No. 4 softener is shown in Fig. 6. Sludge is not accumulating in these units and to date none of the resin beds has been acidized. In the rebuilding of the softeners, the resin was removed, stored wet, and all the resin initially installed placed into two of the units. Unit No. 4 is the new shell with the old resin.

Samples of the resin are periodically removed for laboratory evaluation. A report of capacity and other factors after 18 months operation at 220–234 F. is shown in Table III. Capacity shown for each represents that available under laboratory conditions after preparing the resin by backwashing only.

Palmer type agitators have been useful in maintaining clean resin beds with a minimum of backwash water. After a series of tests in establishing the effectiveness of this mechanism, it can be said that the surface washer contributes to:

1. Reduce the backwash period.
2. Reduce backwash flow rate necessary for sludge removal at high temperatures.
3. Reduce the amount of water needed for backwash.
4. Aids in removal of filtered sludge.

Is Prefiltration Needed?

There has been considerable controversy among the various visitors to this plant as to the necessity of prefiltration. During a shortage of chemicals, operation was attempted without a coagulant for a short period. At flow rates of less than 3 gpm per sq ft through the zeolite units, it was necessary to backwash about every 4 hr to keep the units on the line. During this period, turbidities rose to 20 ppm in the primary softener effluent. It can be concluded here that operation without prefiltration is only feasible when relatively clear water can be fed to the Nalcite HCR softeners. If clear water can be produced through the use of a good coagulant in an adequately designed primary softener, then prefiltration is not needed ahead of hot-zeolite softeners. We feel that the water fed to the zeolite units in our plant normally contains no more suspended matter than found in anthracite filtered water. Water from a hot-zeolite softener is sparkling brilliant. This is not true of anthracite filtered water.

The revised panel board now houses the pH controller as well as the flow meter and integrator for each of the four softeners. A plan of the softener room is shown in Fig. 2. In order to place the 4th unit in this room, transfer pumps had to be relocated. This area is very crowded and if more capacity is needed, a new location will be necessary to house additional equipment.

Cost of Treatment

In large installations, cost of water treatment is a factor given varying considerations. The chemical cost for complete hardness removal from 175-ppm-hardness water by the hot-lime-zeolite system here reported on has been close to 2.6 cents per 1000 gals treated. This is very close to the theoretical cost of treatment by this process, which would be 2.45 cents. Breakdown of chemical usage and cost is shown in Table IV.

The hot-lime-soda secondary phosphate system operated at a cost of 3.75 cents per 1000 gals when treating this same water supply.

We acknowledge the cooperation of the National Aluminate Corp. for the performance of test work and preparation of data included in this paper.

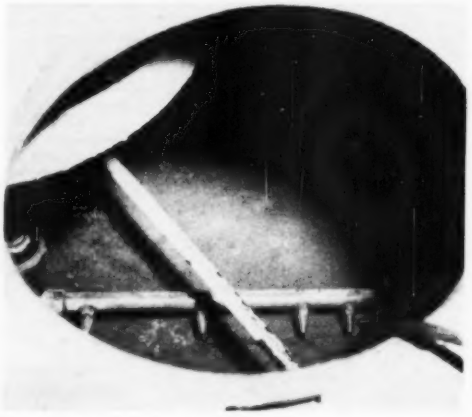

Fig. 6. Internal view in No. 4 softener to show absence of sludge. To date, none of resin beds has been acidized

ASME Holds 72nd Annual Meeting at Atlantic City

Over 3000 members and families attend successful meeting . . . Hear outstanding papers on reheat steam turbines and reheat steam generating units, new power plants of advanced design, fuels and their combustion, cyclone furnace experience, problems of feedwater treatment, gas turbine developments and hydroelectric progress . . . New president inaugurated and honors awarded to leading engineers

FOR the second time post-war, the American Society of Mechanical Engineers held its annual meeting at Chalfonte-Haddon Hall Hotel, Atlantic City, N. J. from November 25 to 30, 1951. Over 3000 members registered, brought their families along, enjoyed a program of fine technical papers, interspersed with interesting social events.

Of special interest to power engineers attending the meeting were papers on reheat turbines and steam generating units. The resurgence of reheat during the past few years has been one of the outstanding features of the power field.

Modern Reheat Turbines

Service experience and recent design progress in modern reheat turbines were detailed by C. Schabtach and R. Sheppard. Most of the turbines 20,000 kw and above shipped by the authors' company in 1948 were for 850 and 1250 psi, 900 and 950 F, while such turbines scheduled for shipment in 1953 are mostly for 1450 or 1800 psi and 1000 or 1050 F and most will employ reheat to 1000 F.

Reviewing the characteristics of recent large reheat units, the authors showed how they are built as both cross-compound and tandem-compound units for high temperature operation. Speed governing systems have been satisfactory; there has been a little difficulty with iron oxide deposits in isolated cases, modifications have been made on intercept valves; control of desuperheating sprays in the cross-over during light load operation or on dropping load has been satisfactory.

Fig. 1. At 72nd Annual ASME meeting at Atlantic City, J. Calvin Brown (left), retiring president, congratulates R. J. S. Pigott, new ASME president

Fig. 2. To John T. Rettaliata (right) this honor award was made by the ASME gas turbine power division for his important contributions to the American gas turbine development. W. J. King made the presentation

Recent units have both initial and reheated steam admitted to adjacent sections, concentrating the highest temperatures in a small region of the high-pressure casing, improving thrust balance and reducing differential expansion. Triple flow exhaust units have been designed for large capacities and there are a number of very large cross-compound units. The authors described several of them.

R. L. Reynolds reviewed the reheat cycle advantages and disadvantages and detailed present developments by his company.

Steam conditions of a number of recent units, over 25 per cent of those now being designed by the author's company, are for conditions of 1800 psig, 1000 F with reheat to 1000 F. He outlined various cylinder arrangements, showed increases in thermal efficiency up to 6 per cent for reheat units at 1100 F and 5¼ per cent at 1050 F, discussed reheat control and concluded the future of reheat is bright, for fuel costs and load factors will probably remain high.

H. E. Stickle reviewed the experience with reheat at Edgar Station where it was first used in 1925. He compared the latest reheat unit there with the first units. Unit No. 4 has had for 1950, a heat rate of 10,250 Btu, capacity factor 88.87 per cent, load factor 88.87 per cent, availability factor 92.08 per cent. The author narrated operating experience, expressed the conclusion that in its 25 years of use at Edgar, there have been no operating difficulties that can be attributed to the reheat cycle.

S. N. Fiala recounted 25 years of reheat operating experience on the AG & E system. He gave the background of modern reheat units, then showed how four units of 217,000 kw each at 2000 psi, 1050 F with reheat to 1050 F are under construction — two for the Kanawha River plant, two for the Muskingum River plant. The net heat rate of these units is expected to be just over 9000 Btu per kwh. He detailed start-up and shut-down procedure on a unit at Philip Sporn plant.

Reheat experiences at Port Washington were given by M. K. Drewry. He gave data on starting schedules, reheat economies, conversion to centralized control of auxiliaries (resulting in total on-site year-round personnel of 0.57 men per 1000 kw), temperature control problems, turbine overspeed control problems, turbine overspeed control in emergencies, availability (average for 1947–1950, for boiler-turbine units, 94.6 per cent).

Reheat Boilers

Reports on details of reheat boiler operation and design were given by W. J. Vogel and E. M. Powell. Control of reheat steam temperature is by use of tilting burners, also by spray type desuperheating as supplementary control at low loads. They gave data on operation of reheat units at Dunkirk, Russell and Titus stations.

First year's operation of the Dunkirk Steam Station was described by J. N. Ewart in great detail. Net station heat rate for September 1951 was 9470 Btu per kwh for two 80,000-kw, 1450 psi, 1000/1000 F single boiler single turbine units.

Other details of operation and performance of reheat boilers were given by P. R. Loughin, H. H. Poor and H. H. Hemenway.

Fig. 3. William L. Batt (right), Minister in Charge of the Economic Cooperation Administration to the United Kingdom, receives the Hoover Medal for 1951 in recognition of his "leadership in engineering, management and public responsibility, and his many distinguished services to his community and the Nation." Making the presentation at the 72nd Annual ASME meeting is Scott Turner. In center is Senator Ralph E. Flanders of Vermont, former ASME president (1935), recently made honorary member of Institution of Mechanical Engineers of Great Britain

New Large Reheat Plants

In a 3-part paper, Philip Sporn, H. A. Kammer and S. N. Fiala gave full details of the two proposed new

(*Continued on page 104*)

I. J. KARASSIK
Assistant to Manager
Centrifugal Pump Division
Worthington Pump & Machinery Corp.

Advises . . .

. . . Know Your Centrifugal B-F Pump Casings

The more you know about them, the better you will understand how and why your pump operates as it does . . . and the better you will know how to operate and maintain it . . . Volute and diffuser type casings . . . Recent developments in casings . . . Axially- and radially-split casings . . . Pressure limits . . . Casing stretch . . . Double-casing pumps—their advantages and details of construction . . . Vital data as pressures go up

CENTRIFUGAL pump casings can be classified into two basic groups: (a) Volute Type; (b) Diffuser Type.

The diffuser type pump has been, and probably will remain, a favored design for high-pressure boiler feed pumps because it leads to the use of a symmetrical casing, excellently adapted to the forged steel radially split construction and very advantageous because of the simplicity of the casting. However, a diffuser has a series of fixed vanes in the path of the liquid leaving the impeller which can only meet this flow without shock at the capacity for which the pump is designed, for only at this condition does the angle of the vanes correspond to the angle at which the liquid leaves the impeller. At all other flows, the multiple vanes will cause shock and turbulence and at very reduced capacities these shocks and turbulences may become sufficiently severe to reduce the total head generated by the impeller. As a result, the head-capacity curve could easily acquire a "droop" in the vicinity of shut-off capacity, rendering the pump unsuitable for satisfactory parallel operation.

The actual form of the diffuser has lately undergone a substantial development, because it has been proved that definite advantages result if the number of diffuser vanes is reduced from the customary six or even ten. With but two or three vanes used, these could be made of more substantial proportions and without losing the advantages of symmetry offered by the principle of diffuser design, the danger of shock losses at light loads is eliminated. Such a "twin-volute" diffuser is illustrated in Fig. 1, A, B and C.

Volute Casings

While the volute casing does not possess the symmetry of the diffuser and is thus less suitable for use in high pressure applications where a forged steel barrel type casing is indicated, its simplicity has made it the favored form of design in relatively low and medium pressures up to approximately 1300 psi, and in some cases, up to 1600 psi. Hydraulically, a volute pump is not so prone to develop a drooping characteristic while, mechanically, its casing diameter is brought to absolute minimum.

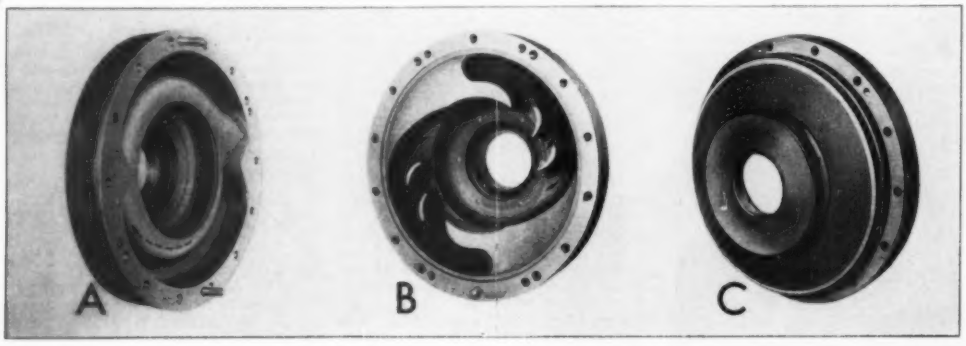

Fig. 1. Details of a twin-volute diffuser type centrifugal pump casing

A—Last stage twin-volute diffuser seen from discharge end. It discharges directly outward into pump barrel. Both volutes are clearly seen
B—Twin-volute diffuser seen from discharge end, showing inward flow to succeeding stage
C—Twin-volute diffuser seen from suction end. Arrow indicates continued inward flow in direction of arrows on Fig. 1-A. Outward flow from impeller is not visible. Approximate curvature can be visualized from photograph of last stage diffuser, Fig. 1-C

This reduction in the casing diameter is especially desirable in axially-split casing pumps as it reduces the wetted area and thus the total force acting to separate the two halves.

The use of the volute form of casing does introduce certain problems. Because of the unsymmetrical disposition of the volute around its impeller there arises a certain inequality in the pressure distribution along the periphery of the volute, which is particularly marked at low flows, and which results in a thrust acting radially upon the impeller. The forces set up by the radial thrust add to those of the impeller and shaft weights and, unless counteracted or eliminated, would increase the shaft deflection to a marked degree.

The solution to this problem used almost universally today, in connection with multistage volute pumps, consists in staggering the various volutes in such a manner that the resultant of the individual radial thrusts is balanced out. This principle is illustrated in Fig. 2.

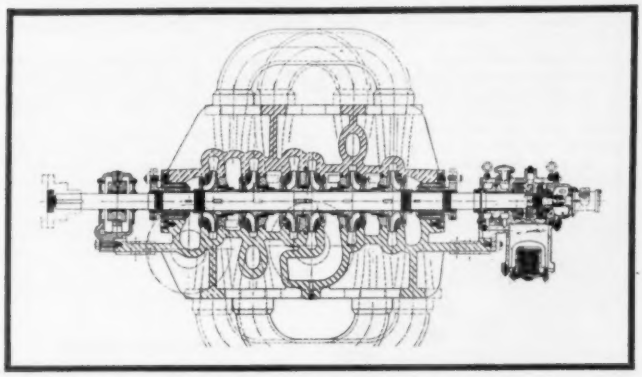

Fig. 2. Section of 6-stage axially-split-casing volute-type boiler feed pumps. Individual volutes are staggered to achieve radial balance

Axially or Radially Split?

The original centrifugal pumps had a vertically-split casing, or rather, a casing with joints in a plane perpendicular to the shaft axis. The idea of splitting the casing in a plane parallel to the axis of rotation was introduced because of the limitations imposed upon the radially-split design by the requirements of accessibility for inspection and repairs.

The opening leading to the suction passages of the first stage and from the discharge of the casing were located in the lower half, with the result that the upper half could be lifted and the rotor laid bare (see Fig. 3) for inspection or removal without disconnecting the pump proper from either its foundations or from the suction and discharge piping. In other words, the change was made strictly for reasons of convenience and expediency, considerations of mechanical strength or of cost entering in no manner whatsoever into the decision. With the growth of steam pressures, the working pressures of boiler feed pumps increased to a point where it became more and more difficult to keep the horizontal gasketed flanges tight against the internal pressure.

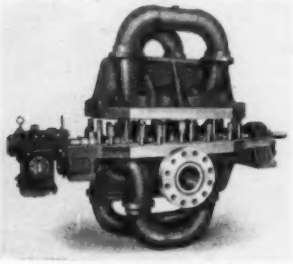

Fig. 3. Axially-split casing volute pump. Lifting upper half of casing exposes impellers and wearing rings for inspection

The solution applied to avoid internal leakage was to increase the thickness of the horizontal flanges, to stiffen the casing against distortion with properly-located ribs and to augment the number and size of the casing bolts. It is evident, of course, that even this solution was bound to lose its effectiveness once certain pressure limits were reached and it is for this reason that some upper limits must be imposed to the application of axially split casings.

Between 1938 and 1948, a working pressure of 1250 psi emerged as the average line of demarcation between axially and radially-split casings. However, within the past two years, the opinion of the various designers as to the proper location of the limits has again varied considerably, with some engineers showing a preference towards reducing this pressure limit to as low as 1000 psi, while others have become convinced that the limit may be safely moved upwards to 1600 psi.

Based on results observed within the last few years, the author's opinion is irrevocably committed to the 1600 psi limit, — that is, based on operation at 3600 rpm. If, as the author believes, boiler feed pumps should be designed in the future to operate at considerably higher speeds and therefore develop greater heads per stage and sustain an appreciable reduction in the area subject to internal pressure, the upper limit of axially-split casings will no doubt progress to 2400 psi and even higher.

As the flanges of an axially-split casing are pulled tight by the action of the bolts, the latter are given an initial stress in tension. The gasket

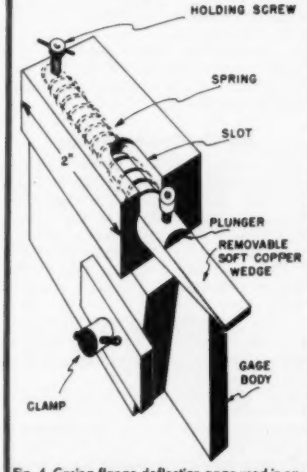

Fig. 4. Casing flange deflection gage used in experimental analysis of soundness of axially-split casing designs

One or more such gages are clamped to the internal ring bores on the lower half of the casing in such a position that the soft copper wedges will be pushed into the split at the adjacent tongue by the action of the spring. Before installation of the gage, the plunger is retracted and secured with the holding screw. Since it is also necessary to determine the amount by which the gasket is compressed by the initial bolting, small pieces of the gasket are removed at the tongues, so as to obtain this measurement by means of feeler gages.

After the gages are installed, the upper half of the casing is put in place and the casing bolts are tightened up in the usual manner. By reaching into the stuffing box openings it is then possible to release the holding screws of the gages. The soft copper wedges are therefore pressed against the closed split under spring pressure, ready to enter further as soon as casing deflection occurs. It is also possible at this time to reach in and measure the gasket compression under initial tightening with a feeler gage.

End plates are secured on the stuffing box openings and the casing is subjected to the desired hydrostatic test pressure. The copper wedges penetrate into the split to the extent that it is opened up. After the casing has been held at this pressure for the required length of time, the pressure is released. This causes the two casing halves to return to their original position prior to the deflection under test and an indentation is made on the soft copper wedges at an easily measurable point. This indentation permits determining quite exactly the extent of the casing deflection after the casing is opened up and the gages removed. As stated before, comparison of this measurement with the restoration curve of the gasket material under varying stresses will determine whether the selection of the size, number and location of the bolting material, of the stiffening ribbing on the casing and of the gasket material combine to determine whether the casing will remain tight under the desired pressure conditions.

itself is subjected to a compressive stress, which is determined by the stress in the bolts and by the relative areas of bolts and gasket.

As internal pressure is applied, the bolt stress increases to a new value and the bolts increase in length. Assuming that the deformation of the gasket at the time of initial tightening is not permanent — in other words, that the gasket stress does not

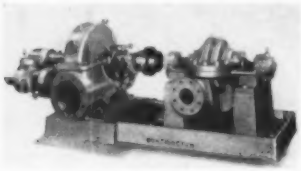

Fig. 5. Two-stage axially-split casing volute boiler feed pump for small capacities and pressures up to 200–250 psi

exceed the yield strength of the gasket material and that it possesses sufficient restorative properties — the thickness of the gasket will increase by the same amount that the bolts were increased in length. The gasket compressive stress is reduced, but remains high enough to prevent leakage between the flanges.

The distribution of the bolting of the axially-split casing flange of a boiler feed pump presents a very complex picture and it is not practical to conduct a strictly analytical study of the quality of the joint under a combination of varying internal pressures at the individual stages.

Experimental measurement of casing stretch can be obtained by means of special gages, as shown in Fig. 4.

Axially-Split Casings

In the low and medium pressure and capacity range, interstage passages are cast integrally with the casing proper, as shown in Fig. 5.

As the pressures and capacities increase, the desire to maintain as small a casing diameter as possible, coupled to the necessity of avoiding sudden changes in the velocity or the direction of flow, leads to the use of external interstage passages, Fig. 6, cast separate from the casing. They are formed in the shape of loops, bolted or welded to the casing proper.

A multi-stage pump has adjoining chambers subject to different pressures. These chambers must be isolated from one another, so that the leakage from high to low pressure will take place only at the clearance joints formed between the stationary and rotating elements of the pump and that this leakage be kept to a minimum. The isolating wall used to separate two adjacent chambers of a multistage pump is called a stage piece, diaphragm or interstage diaphragm. The stage piece may be formed of a single piece or it may be fitted with a renewable stage piece bushing at the clearance joint between the stationary stage piece and the part of the rotor immediately inside the former.

To obtain a satisfactory seat between a solid interstage diaphragm and an axially-split casing, it is wise to make a pump with the smallest possible casing diameter. Each diaphragm, furthermore, must be so arranged that the pressure differential which is developed by the pump will tend to seat the diaphragm tight against the casing rather than open up the joint. In order to further insure this tightness of seating, some designs incorporate an elastic seal lodged in the face of the diaphragm contiguous to the casing.

Radially-Split Casings

The oldest form of radially-split casing multistage pump is that commonly called the "ring-casing" type or the "doughnut" type. When it was found necessary to use more than one stage for the generation of higher pressures, two or more single stage units of the then-prevalent radially-split casing type were assembled and bolted together.

The sectionalized design presented a problem of dismantling, for the suction and discharge nozzles were attached to the heads and the pipe connections had to be broken each time the pumps required dismantling.

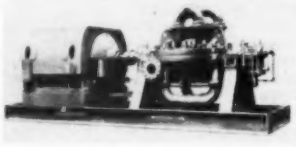

Fig. 6. Centrifugal volute pump with chrome steel casing and sleeve and Kingsbury thrust bearing

The desire to alleviate the dismantling difficulties of the "doughnut" type pump while still retaining the mechanical advantages of the radially-split casing led to the development of the so-called "double-casing" pumps.

Double-Casing Pumps

The basic principle of the double-casing pump consists in enclosing the working parts of a multi-stage centrifugal pump in an inner casing and in building a second casing around this inner casing. The space between the two casings is maintained at the discharge pressure of the last stage of the pump.

The construction of the inner casing follows either one of two opposite principles: (a) Axially-split casing; (b) Radially-split casing.

The first of the two is a simple evolutionary step from the usual low-pressure practice of single-casing axially-split pumps. Since the outside of the axially-split casing is subjected to a pressure greater than the average internal pressure, the inner casing is under compression and the horizontal flanges will remain tight under any operating conditions. Generally, the inner casing of this type of pump is of the volute type.

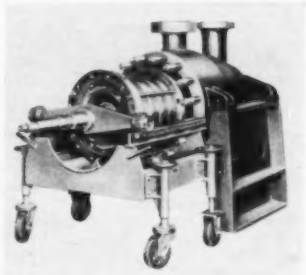

Fig. 7. Radially-split inner-casing element being inserted into outer-casing barrel

The double-casing pump with a radially-split inner casing shown in Figs. 7 and 8 is an evolution of the usual ring-casing type pump with provision for the ease of dismantling which the latter type of pump lacked. The inner casing is constructed exactly like a ring-casing type pump. After assembly it is inserted into a forged-steel cylindrical casing in which it is centered and bolted at one end, while it is free to expand axially in a sliding fit within the discharge head at the opposite end.

Fig. 7 illustrates the insertion of the inner element into the outer casing, while Fig. 8 shows the external appearance of such a boiler feed pump. The suction and discharge nozzles form an integral part of the outer casing in order to permit the removal of all interior parts of the pump without disturbing the pipe connections. These nozzles are located on the vertical centerline of the casing, either top or bottom, to prevent eccentric strains from the piping which might disturb the alignment of the unit. The most important advantage of the principles employed in this construction is that perfect symmetry is retained for all parts of the pump and that all the high pressure and all interstage joints are of the ring type, which is most easily held tight under high pressures.

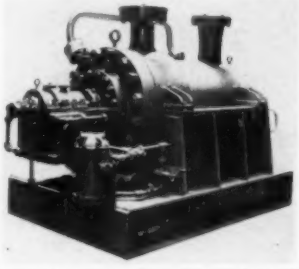

Fig. 8. Exterior appearance of radially-split double-casing boiler feed pump

The PRACTICAL ENGINEER *and* ELECTRICIAN

ANDREW W. KRAMER, EDITOR

WHY USE STEAM TO OPERATE TURBINES?

When S. J. W.s question, "Why use steam to operate turbines? Why not compressed air or high-pressure water?" (No. 488, Sept. issue) first came to our attention, we thought it a rather silly question. It seemed to belong to the category of straw men, which are set up only to be knocked down. Its implications, however, were intriguing, and further reflection indicated that its seemingly trivial nature stemmed from the fact that it involved something so well known that few people questioned its basic significance. Its basic significance, of course, is embodied in the Second Law of Thermodynamics, but like many other concepts inherent in the Second Law, it is difficult to translate its abstract nature into terms of practical understanding. In dealing with the subject of energy we are concerned with various degrees of randomness or disorder, and the positive measure of this disorder is what we call entropy—one of the most fundamental quantities in physics. The Second Law states that in an isolated system, the probability that entropy shall decrease is zero. In practical experience, this means that heat cannot flow from a cold body to a hot body.

Now, a steam turbine is a heat engine, and all heat engines operate by virtue of a drop in temperature. Remember the Carnot cycle equation for thermal efficiency, $e=(T_1-T_2)/T_1$. (T_1 and T_2 are absolute temperatures). Note that there is no term denoting pressure in this expression. Pressure, of course, is inherent in the thermal energy of the steam.

Mechanically, compressed-air turbines resemble steam turbines, and thermodynamically, also, they can be regarded as heat engines since, in the expansion of the air as it passes through the turbine, it undergoes a drop in temperature. The temperature level at which such machines would have to operate, however, would be much lower than that feasible with steam, and

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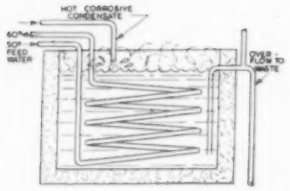


Fig. 1. A method of recovering heat from contaminated hot condensate

Recovering Heat From Condensate

By **LEO WALTER**, Consulting Engineer

Wherever steam is used, condensate forms . . . Heat recovery from condensate has proved economical . . . Many plants are not taking full advantage of this available heat, so here are some suggestions which may help you operate more efficiently . . .

WHEREVER steam is used, condensate forms, and has to be drained from pipe lines, steam coils, or jackets. Since condensate, even at atmospheric pressure contains a considerable amount of heat, it is only good engineering to recover this condensate and to use it over again. Not only is heat conserved but the amount of makeup needed is reduced.

Despite general knowledge of the savings possible by the recovery of condensate there are still many instances where it is permitted to go down the drain. Simple calculations will show that in such cases money is being wasted and that it could be saved by the use of simple methods of condensate recovery. It is the purpose of this article to describe some of these methods.

In general, there are three methods in which the heat in condensate may be recovered. These are:

1. Return to the boiler feed supply
2. Use of heat in the *flash steam* from re-evaporation of condensate
3. Recovery of heat from condensate before its discharge through traps.

Condensate Return to Hotwell or Feed Tank

Several systems for the return of condensate to the boiler feed supply have been developed and while the equipment used in these systems has been improved in recent years by more compact design, the basic principles underlying their operation remain the same. All of them involve the return of the condensate to the boiler or hotwell by means of gravity, traps or pumps. In cases where the condensate is contaminated, it is passed through a heat exchanger in which the heat of the condensate is given up to pure feedwater and the condensate itself discharged to the sewer. Such an arrangement is shown in Fig. 1.

In all such systems it is obvious that it is necessary to provide adequate insulation on all the return lines and on the hotwell itself. Where the distance between the traps and the hotwell is great a condensate booster pump should be installed to speed the water back to the boiler. Sometimes a pumping trap can fulfill this purpose.

If, through the recovery of heat in this fashion, the water in the hotwell becomes too hot to be handled by the existing feed pump, several things can be done. First, it may be possible to increase the suction head on the feed pump by lowering its location with respect to the hotwell. Second, cold water can be added, up to the maximum amount of feed the boiler requires, but not more, otherwise heat will be wasted. Third, the heat in the condensate may be utilized before it flows back into the hotwell. As will be shown later, one way of doing this is by the collection of flash steam from steam traps. Another way is to branch off the condensate return and lead it through a cold water tank so that part of the condensate will be cooled. This is then mixed with the hot portion.

Another way to use contaminated condensate is shown in Fig. 2. Here, condensate from traps on the high-pressure system collects in a flash tank. The flash steam from this tank is used to heat feed water in the manner indicated. This arrangement can be modified to suit various industrial processes. In a plating installation for example it has been used where the condensate might be contaminated by acid. The whole of the condensate, however, is used in the hot swilling tanks where the parts to be plated are washed.

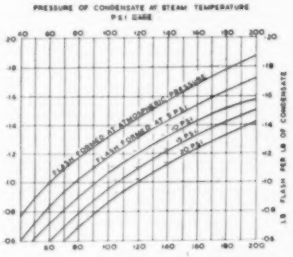


Fig. 3. Flash steam formation curves

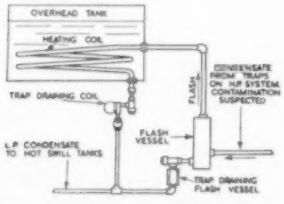


Fig. 2. An application of condensate usage in a plating operation

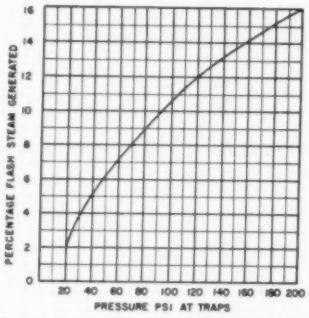


Fig. 4. Curve for flash steam utilization at 10 psi

Flash Steam Recovery

Re-evaporation takes place when hot condensate is discharged through steam traps from steam pressure to atmospheric pressure. Whenever condensate temperature attains its boiling point at reduced pressure, steam will form. For example, if condensate looses 60 C, the excess heat thus created will flash off steam. This

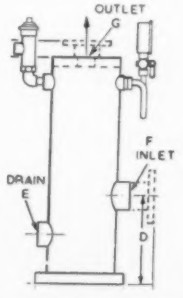


Fig. 5. Flash vessel with safety valve, pressure gage, and connections

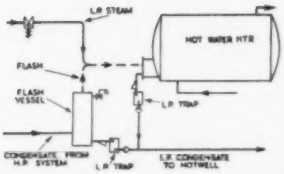


Fig. 6. Flash steam system as used in hot water heater

flashing-off happens with a tight steam trap and must not be regarded as blowing off live steam. The amount of flash steam formed from discharged condensate depends on the pressure drop, i.e., on steam pressure and on the volume of condensate. Figure 3 is a graph showing flash steam formation in pounds. Using this graph, it is possible to calculate the amount of flash steam available

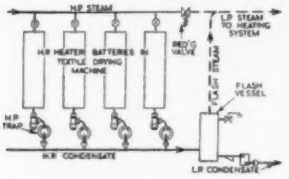


Fig. 7. Flash steam system between heater batteries of dryer and space heating system in the textile industry

from any number of discharging steam traps. Figure 4 is also a helpful chart. With it you can calculate the percentage of flash steam formed when condensate at steam temperatures and pressures up to 200 psi is discharged to a flash steam recovery system working at 10 psi.

Examples of Flash Steam Usage

The following examples of flash steam usage are typical for a recovery system developed in England and now widely used in America. As shown in Fig. 5, all that is required is a cylindrical vessel with three connections (inlet, outlet, and drain). Figure 6 shows how this piece of equipment is used. The hot condensate from a high pressure system is collected in the flash vessel where flash steam forms and is then conveyed to a heating coil in a water heater. Naturally, as heat is taken away from the steam it condenses. The main condensate goes to the hotwell via a low pressure steam trap. Hot water can thus be generated and stored in a large water heater.

Another example of flash steam utilization is shown in Fig. 7. Here, high pressure steam is used in four heater battery sections of a textile drying machine. As in the other example, condensate from the heater batteries collects and expands in a flash vessel. In this case, the flash steam is conveyed to the low pressure space heating system in the factory during the heating season.

Where high pressure steam is used in high pressure evaporators, the installation of a flash tank as shown in Fig. 8 can produce low pressure steam for process work or for space heating systems.

Flash Recovery In Stages

There are some instances where it is possible to recover and use flash steam in stages. Figure 9 illustrates a two-stage set-up. Unit A is an evaporator with a working pressure of 200 psi. Condensate discharged by the trap on this evaporator is connected to a heating battery working at a pressure of 100 psi. The residue of condensate from flash vessel No. 1

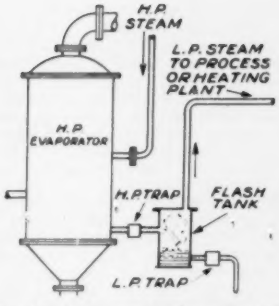


Fig. 8. Flash steam recovery from evaporator

and the condensate discharged by the trap on the heating battery is taken to flash vessel No. 2. The flash steam generated in this vessel is fed to the heating coil in a hot water

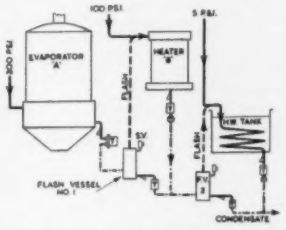


Fig. 9. Two-stage flash steam utilization

tank at a pressure of 5 psi. The residue of condensate from flash vessel No. 2 and the condensate discharged by the trap at the end of the tank coil, is then connected to the return main to the boiler feed tank. The condensate temperature is approximately 227 F.

Tough and Curious Problems

By WILBUR G. HUDSON

In the Practical Engineer section of the December 1951 issue were related a number of problems from the notebook of Wilbur G. Hudson when he was a field engineer for a large manufacturing company which manufactured heavy conveying machinery. They are indicative of the many and often baffling situations the field engineer has to solve in doing his work. Here are several more problems from his notebook which help emphasize the varied down-to-earth knowledge and judgment that the practical field engineer must have

ONCE in a lifetime comes an occasion like this, unless the mental degradation has become chronic. For a large utility, we designed a very clever coal handling system priced at $150,000, erected. The writer was advised by the purchaser's representative who received bids, that the layout was good, but the price was suspiciously low (!) in comparison with two other bids received with figures $20,000 higher. He suggested the quoted figure be increased $10,000 and he would recommend acceptance. The writer, quite dazed, departed and revised the figure upward as requested, with much misgiving.

High Finance with a Kickback

Sure enough, the order came along in a few days. Of course with this velvet, the job was "chromium plated." Six months later at a luncheon, the kind man mentioned

sadly that he must send his wife to Bermuda for her health — "Would you mind signing as a reference my application for a $5000 loan from the Morris Plan Bank?". Of course not. Also of course, three months later, a demand for $5000 was received from the bank. Just how this transaction was worked into our income tax report is not recalled.

Beware of Get-Rich Schemes

The golden opportunity to get rich quick comes only rarely to the engineer. That is why he grabs it quickly when it does. We had built and put into operation a placer gold reclaiming plant costing about $300,000 near Butte, Montana. It had a capacity of 10,000 yards per day, so even with a gold content of 30 cents per yard the operation was profitable. Sometime later a man with little bottles of granular placer gold asked for a proposal on a similar plant for his tract, where test borings had shown the gold content to average above $1.00 per yard. While the estimate was being prepared, he placed a $10,000 cash order for a shovel to clear away the over-burden. He became well acquainted with the engineering staff, and kindly accepted offers of participation from quite a number, ranging up to $7500 each. Shortly, an order from the top brass instructed us to cancel his shovel order and return his $10,000. It appeared he was soliciting subscriptions with the statement that the company was financially interested in the project. Nothing more was heard until about a year later, when a high dignitary of the Catholic church started suit for the recovery of $100,000 of church funds he had invested on the strength of the man's representations. Consternation struck the hearts of the participating engineers, but they were assured the work was proceeding. They could have their money back if they wished. They all did — and got it. Two years later the papers carried accounts of the man's trial, conviction and sentence of two years imprisonment for using the mails to defraud. Opportunity knocks but once, but this one came close to knocking a bunch of trusting engineers for a loop.

Read the Small Print on Contracts

Government contracts harbor nice possibilities of trouble in the *small print* forming the supplement to the specifications. An order for the Navy supply base not far from Norfolk, Va., included a coal storage silo, the usual crushing and conveying equipment, and a motor-driven weigh larry from under the silo through the boiler room, where it was to be suspended from the roof trusses. There was a penalty clause of $100 per day. Another contractor had not finished the boiler house steel structure when we had gone as far as the larry work. The U. S. engineer at the yard was asked to let us know when the roof trusses were in place. Three days work would finish our job. Some six weeks later this was done, and in due course final payment was received — less $3000 penalty. The government man explained that paragraphs numbered so-and-so in the fine print provided that if the contractor should be held up for any reason, he must apply in writing for an extension of time. So they did! It looked bad. There was not much more than $3000 profit in the job.

As a long chance, I stopped off in Washington on the way home to call on my Senator. He listened with interest to my sad story and got busy. First he bawled out the Admiral who was chief of the Bureau of Yards and Docks, then told the Secretary of the Navy what he thought of him. Finally he told me to go home, and a check would be along shortly. It came. It sure pays to read the *fine print* in a government contract.

His Honor Charges the Jury—

Case of the People vs Heat and Humidity

By C. T. BAKER

In spite of the fact that an ultra-modern Federal Court House in a Southern city was equipped with a modern air conditioning plant, neither the judge, the jury, or the spectators were comfortable on extremely hot days. Inspection to determine the cause of the installation's failure to perform disclosed some interesting facts which may be helpful to those who at some time may face similar problems

THE COOLING equipment for the air-conditioning system of a modern Federal Court House in a southern city consisted of two Freon compressors, two water cooling units, two shell and tube condensers and two air cooling units which were equipped with water sprays for air washing. This was accomplished by spraying water over the fin coils located in the lower section of the unit.

Refrigerated water was pumped from the water chillers in the basement through the fin coils of each of the air conditioning units and returned to the pump section for recooling. Two 30-gpm pumps designed to operate against 85-foot head handled the water.

All control equipment was the best that the market afforded and the operation was entirely automatic. The equipment had been well laid out and properly installed.

Coolers Froze — Heads Burst

In a talk with the plant operator, it developed that the head on one of the shell and tube water chillers had burst on three occasions because water froze in the cooler. This resulted in the loss of considerable Freon and expensive repairs as in each instance new heads had to be installed.

Operating Data

As court was not in session, the plant was not in regular operation at the time of the investigation, however, for the purpose of taking operating data and observing over-all performance, the machinery was started up. The following data were recorded:

Speed of each compressor	360 rpm
Suction pressure measured at the compressors	22 psig
Evaporating temperature corresponding to 22 lb	22 F
Temp of water entering cooler No. 1	78 F
Temp of water leaving No. 1	42 F
Temp of water entering No. 2	78 F
Temp of water leaving No. 2	36 F
Cooling range of No. 1 cooler	36 deg
Cooling range of No. 2	42 deg
Pressure gage reading on pump discharge	82 psig
Static pressure at suction inlet of pump	80 psig
Difference between pump discharge and suction inlet pressure	2 psi

This tabulation shows clearly two things are not according to Hoyle. First, the temperature range between the water entering and leaving the coolers was out of reason. Second, the suction pressure at the compressors was much lower than normal operating conditions would warrant.

To permit a further examination of the equipment, the plant was

shut down. The screens were removed from the suction strainer on each pump suction line and were found to be almost completely stopped up with wood shavings, granulated cork and other foreign matter. Here was a part of the answer to the frozen cooler heads, and the remainder was found in the low water temperature cut-out which had never been properly adjusted to protect against freezing. The condensing water pump had not been delivering water as it should. When the suction strainer screen was removed, it too was found to be nearly closed with dirt.

The next step was to remove the suction strainer screen on the suction inlet of the two Freon compressors. Here, again, was found plenty of pipe scale, granulated cork and other debris. As a further check on these three pumps, a pressure gage was installed between the pump and the strainer of each. Now, when the pumps were delivering rated capacity, any change from normal gage reading is reflected in a drop in suction inlet pressure in ample time to anticipate trouble from strainers that are slowly collecting foreign matter. After these faults were corrected, the plant was placed in operation with the following results:

No. 1 Unit	
Suction pressure at compressor	36 psig
Temperature corresponding to suction pressure	40 F
Temperature of water entering cooler	56 F
Temperature of water leaving cooler	52 F
Cooling range	4 F

No. 2 Unit	
Suction pressure at compressor	38 psig
Temperature corresponding to suction pressure	42 F
Temperature of water entering cooler	55 F
Temperature of water leaving cooler	51 F
Cooling range	4 F

It is evident from a comparison of the *before* and *after* situations, that the suction pressure was raised 16 lb in one compressor and 14 lb in the other after the cold water circulating pumps began to supply the coolers with heat. Naturally, this increase in evaporating pressure produced a substantial increase in compressor capacity, as compressor capacity is a function of the absolute suction pressure.

A decided improvement in the temperature and humidity conditions in all air conditioned enclosures followed these improved operating conditions. Wet and dry bulb temperatures and relative humidities in all air conditioned rooms were found to be entirely satisfactory.

Court Room Was Like a Dog House

While checking up on the performance of the compressors and water circulating pumps, I was advised that conditions in the Court Room had never been satisfactory since the plant had been placed in service. Temperatures and humidities were high, odors were bad and judge and jury were irritated.

When this phase of the operating troubles was investigated, some interesting things came to light. The return air damper controlling the return air from this room to the plenum chamber at the location of the air conditioning unit was completely closed. Naturally, this prevented the usual air changes and created a stale, tobacco-laden air. No one could be found that could explain the reason for the damper being closed, neither could anyone be found who would admit the act. It still remains one of the "unsolved crimes" against the people. Shortly after the closed damper was opened wide, conditions began to improve.

No Attic Ventilators

The plans for the structure did not call for exhaust fan ventilation of the attic above the air conditioned rooms. One of the air conditioning units previously mentioned was located in this attic where the dry bulb temperature at times reached the grand total of 117 degrees. This condition was later corrected by the use of exhaust fans and the installation of more liberal louvres in the walls above the attic.

As the investigation drew to a close and the Court Room became entirely comfortable, one of the lawyers trying an involved case was heard to shout, "Your Honor, the statement of the learned Counsel for the Defense is incompetent, irrelevant, and immaterial".

"That's not the nomenclature of the Engineer", remarked the plant operator, "It must be the Law."

PRACTICAL HINTS AND KINKS

OPEN YOUR CENTRIFUGAL PUMPS REGULARLY FOR INSPECTION

PUMPS ARE by far the most important auxiliaries in most plants, because they supply the necessary fluids for operation. Consider a boiler feed pump upon which depends uninterrupted steam generation and boiler safety.

When the pump is installed, a program should be instituted for its proper operation and care in accordance with conditions outlined in the manufacturer's operating manual. You can determine the actual condition of a pump and the repairs required, after a predetermined period, only by dismantling and thorough inspection. This should be done at least once a year — oftener if water and operating conditions are unfavorable. In many large industrial and public utility plants where continuity of operation is an absolute requirement, all important pumps such as stock, boiler-feed and mill water supply are opened annually for examination according to *The Condenser*, a publication of the Mutual Boiler and Machinery Insurance Company.

In the case of large, multi-impeller pumps, it is advisable to have a manufacturer's service engineer supervise the dismantling, repair, and reassembling of the unit. By so doing, you are obtaining the benefit of the manufacturer's experience, know-how and research. Many large industrial and public utility operators follow this course.

After the pump is opened, all internal parts should be carefully examined for wear, fracture, corrosion, erosion and cavitation.

Insufficient head on the suction has been responsible for many of the troubles experienced in boiler feed pump operation. In high pressure pumps, excessive wear has resulted from inadequate circulation of water during off-pumping periods. If there is inadequate head or losses are excessive, a sudden demand for boiler water may cause the suction head to drop to where the water will flash into steam and thus result in pump failure due to overheating. In most cases this condition will be evident from the condition of the channel rings, sealing rings and shaft where it will be seen that the rings are scored and the shaft distorted or bent.

A centrifugal pump should be dismantled by removing the top cover, rotor, and bearings, and, beginning at the coupling end of the machine, the examination should proceed as follows:

1. **Couplings:** Condition, wear, lubrication and alignment
2. **Main shaft and shaft sleeves:** Condition, wear, erosion and corrosion
3. **Bearings:** Condition, wear, clearance and lubrication. This will include the thrust bearing which is usually incorporated in the outboard main bearing
4. **Oiling system:** Condition of oil, amount of sediment and grit found in reservoir when it is cleaned
5. **Stuffing box glands:** Condition of glands and packing
6. **Impellers:** Condition, amount of erosion, corrosion and cavitation
7. **Wearing rings:** Condition, wear, corrosion, erosion and clearance
8. **Channel rings:** Condition, wear, corrosion, erosion and clearance
9. **Diffusion rings:** Condition, wear, corrosion and clearance
10. **Hydraulic balancing device:** Condition, wear and clearance
11. **Casing:** Condition, corrosion and erosion
12. **Gear oil pump, when required for service:** Condition and wear.

Special attention should be paid to the clearance between the stationary and rotating parts of the pump. They should be held to the limits set by the manufacturer, because the safety of the pump and its efficiency depend upon them. Therefore, they should be compared at each dismantled inspection and the manufacturer consulted when necessary.

INSULATED HOT ASH LINE PREVENTS BURNS

MINIMUM man-hours lost through on-the-job accidents is the constant objective of operating managers and safety engineers in steam and electric power generating plants. Although its most common function is to cut heat loss, thermal insulation has helped up-to-date power plants maintain exceptional safety records by preventing accidental burns where high-temperature equipment is located at floor level in working areas frequently used by employees.

Alert engineers at the Long Island Lighting Company's 170,000-kw Glenwood Power Station on Long Island, for example, anticipated the danger of accidental burns where a vertical pipe line containing 350 F ash passed only a few inches from the right handrail of steps at one of Glenwood's connecting doors. The possibility of burns was virtually eliminated by covering the 8-in. line with $1\frac{1}{2}$ in. thick molded type pipe insulation and a $\frac{1}{2}$-in. layer of mineral wool cement up to about 6-ft above floor level. The pipe insulation was finished by covering the mineral wool cement with a single layer of asphalt paper and 10-oz canvas which was glue-sized and painted.

Distributed through the vertical pipe line from a boiler ash pit to outdoor ash silos, the ash itself is

This shows the hazard and how job looked, described above, when finished

waste, and heat recovery is impractical. Reduction of heat loss from the insulated pipe is therefore of little importance. Throughout many power plants, thermal insulation is similarly applied to save dollars in fewer accidents as well as reduce heat loss.

PROTECT INSULATION AGAINST MECHANICAL DAMAGE

BECAUSE no insulating material can withstand repeated mechanical abuse, special protection should be provided at points where insulation may be subjected to more than ordinary wear and tear.

Due to the layout of lines or equipment, as when lines are located at floor level near stairways, ramps or platforms, it may be impossible to prevent battering of insulated surfaces. Sometimes chains hanging from overhead chain hoists strike repeatedly against insulated lines or equipment.

Insulation that is exposed to such mechanical abuse may be protected by means of a sheet metal jacket which will cover the entire area of possible damage. The jacket may be tack-welded, or held in place with screws or bolts.

Where required, expansion joints with spring-loaded bolts may be provided in the jacket to compensate for circumferential expansion. Longitudinal expansion is permitted by lap seams at intervals of approximately 12 ft.

Sheet metal jacket bolted over steam line to protect the insulation from damage

GROUND DETECTION WITHOUT PRODUCTION INTERRUPTION

A GROUND detection device has been recently introduced which permits tracing grounds on *hot* systems without interrupting the flow of power or affecting production. The Allen Ground Detector superimposes

Fig. 1. Operator at controls of signal generator unit of ground detector

a 50 times per minute pulsating alternating signal current on the grounded phase conductor. A hand detection unit is used to trace this signal current through the grounded phase directly to the ground. If the detection unit is moved beyond the ground, the 50 times per minute rise and fall of the needle on the meter stops. In this way the ground can be traced right to the spot without the need for turning off any power flow. A ground on a plant's power distribution system can usually be found by the common process of elimination technique of opening a few switches here and there.

With this method, however, either production has to be interrupted as switches are opened or else the job has to be done at night. More often

Fig. 2. Operator with hand detection unit used to trace signal current through grounded phase to the ground

than not, the ground then will have disappeared because it happens to be in the wiring of some machine that has been shut down for the night. If the job is done during the day despite the interruption of production, there is always the danger that a machine will freeze or some other costly accident occur.

At a South Bend, Indiana, plant the new device has been used with great success. This plant has fourteen load center substations fed by 4160-volt feeders from the main substation. These substations supply 1,500,000 square feet of floor area through plug-in bus way conduit enclosed feeders and cables. Prior to using the new system of finding grounds the company had to start out from the main substation, pulling breakers until the ground could be found.

Under the new method, the saving in man hours and production time will pay many times over the unit's cost.

In anywhere from five minutes to an hour-and-a-half, two men can track down any ground that develops. One man operates the main unit which is connected to the grounded bus, revealed by the usual ground detection lamps on the system, while the other traces the pulsating signal with the hand unit along conduits, cables and bus way until the signal stops. Within a few minutes thereafter, the ground is removed and all dangers that are always possible when a ground develops are cleared. The first ground on the system is not dangerous; it is the next one that develops for it shows up on another phase. It is possible for the short circuit to cause serious damage.

In its log of cleared grounds, the company has uncovered a tricky ground in the control wiring of a small laboratory furnace and another in a ½-ton hoist, both of which would have been difficult and time consuming to find by the old former method.

CAN YOU PAINT A STRAIGHT LINE?

By W. B. KENNEDY

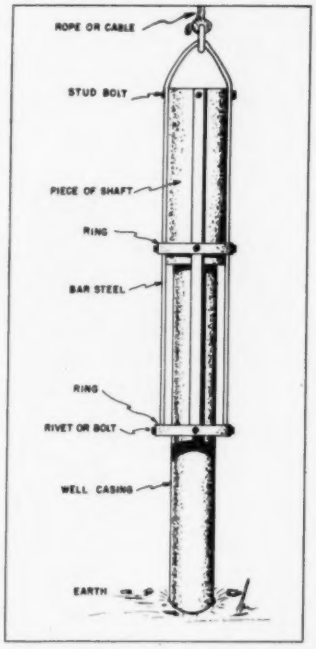
WHEN YOU want to paint a straight line on a wall, adhesive tape may be used to advantage as a guide. It should be put on the line carefully. Then if any paint gets out of place during application, or while drying, it is on the tape, which shouldn't be removed until paint is dry.

This idea is particularly applicable in painting signs, or doing any decorative work on walls where neatness and absolute accuracy or straightness are necessary. If the tape is properly applied to the wall, paint will not penetrate the surface beneath the tape, producing irregularities as often occur when a wooden strip is used as a guide for the paint brush.

A HOMEMADE CASING DRIVER

By J. A. GARRITY

A USEFUL casing driver can be constructed as shown in the illustration. Obtain a piece of steel shaft with a diameter exceeding that of the casing to be driven. The length of the shaft determines the weight of the finished driver.



How driver should look when assembled

Drill four holes equi-distant in the circumference near each end and thread them to accommodate stud bolts. Next obtain bar steel of suitable size for making cage bars. Four are required and in most cases the dimensions may be varied to suit the material available. Two of the cage bars may be combined in one to form the bail required at the upper end or a bail may be added after making four bars all alike.

Two or more rings should be used to strengthen and hold the cage bars in the correct position. The ring at the bottom end of the hammer proper is held in position by stud bolts, while the one at the lower end of the cage is riveted or held in position by short bolts.

After the casing has been placed in the hole, this driver is used by hoisting the hammer as high above the upper end of the casing as the length of the cage will permit, without the possibility of the device swinging out of line with the casing and missing its mark. Then it is dropped suddenly to force the casing downward into the ground. The cage slips up and down on the casing, guiding the hammer correctly. A drive cap may be used on the casing to avoid damaging threads, if desired. The device may be modified to suit individual requirements and material available.

TROUBLES WITH TWISTED BELTS

By E. C. REED

IF YOU HAVE ever had occasion to use twisted belts, you have undoubtedly noticed they refuse to center on both of the pulley faces when they are aligned, except when the pulleys are of the same size in diameter. A slight variation in face diameter usually does not matter provided each of the pulleys is at least wide enough to accommodate the belt being used.

As an example, a twisted belt is put on a 5-ft drive pulley, with a 10-in. pulley at the other end. Looking from the drive pulley end, give the belt a left-hand twist. When the belt is tried with the pulleys aligned, it runs to the right and off the smaller pulley. It is then necessary to move the machine carrying the 10-in. pulley before the belt will stay on the pulleys and center the faces as they should be. When the spot is found where the belt runs correctly, the smaller pulley will be several inches too far to the right to be aligned with the larger one. This brings up the question of determining the proper location for bolts in concrete foundations for machines equipped with cast bases provided with bolt holes that can not easily be altered. Also, it may not be possible to move the smaller pulley either to the right or left. In that case, what could be done if the belt refused to stay on the smaller pulley after the machine was stationed on the concrete foundation?

All these things may be considered poor practice by some, but all sorts

of problems arise and they cannot be solved by any standard rules. In other words, if a machine under these conditions cannot be set up temporarily and the belt tried before deciding upon the location of the bolts in the foundation, then it all depends upon guesswork and the belt may run correctly or it may not run at all. If any engineer has devised a set of rules for locating pulleys to carry belts with right-hand and left-hand twists with great and varied variations in pulley diameters, disregarding face diameters, it would be handy information to have available. If a problem cannot be ignored, it must be solved.

HOW TO USE JETS

By W. B. KENNEDY

EXPERIENCE with jets has shown that they work best when located just above the water, whether in a vertical installations, as in a well, or in a horizontal installation, as when forcing water from a stream to a point some distance from the source. About the only thing that causes trouble in a vertical installation is exhaustion of the water supply. In horizontal installations, sagging steam or water lines may cause trouble. A sagging water line isn't apt to cause trouble except in case of a freeze where the temperature is low enough. In cold climates, freezing may occur in the water line even when the jet is being continuously operated. In a sagging steam line, the pipe may collect enough condensate to clog itself with water to the extent that steam cannot reach the jet before condensing. This, however, can be avoided by giving all the pipe the same amount of pitch. Sags positively must be avoided, or a means of draining the pipe provided, so that steam can reach the jet.

Locating the jet just above the water in the case of a horizontal installation may be said to have one disadvantage in that in such an installation, when a foot valve is used on the end of the suction pipe, the water line is always full of water after stopping the jet. Also, gravity may cause this water to drain back down the water line, going exactly half-way and flooding half of the steam line. Then the steam cannot reach the jet when the former is turned on. This renders the use of a foot valve on the suction pipe impracticable, unless the water line is so nearly on the level throughout its entire length that the steam line can be located high enough to prevent flooding and still permit steam to reach the jet before being condensed by water.

Experience shows that jets with a steam entrance or opening located parallel with the discharge are more satisfactory than those which have vertical openings or, in other words, open at right angles to the discharge or suction end. Horizontal or parallel openings are usually preferred instead of a vertical one because when steam is turned on, the jet with a vertical or right angle opening, expansion in the steam line often causes the line to break at the point where it enters the jet. Horizontal jets are more often used because their construction is such as to divide the strain of expansion evenly throughout the steam line.

Water has been pushed a distance of 600 ft with a 15 ft vertical lift by putting the jet just above the water. It must be understood, however, that a jet must never be submerged in water because this causes the steam to condense before doing the desired work of forcing the water upward through the discharge line.

EFFECTS OF OVERLOADING AND SINGLE-PHASE OPERATION

ALL TOO FREQUENTLY a motor of adequate capacity properly applied to the original application is later found to be overloaded or otherwise unsuited for its job.

Connecting instruments in the motor circuit will quickly disclose the reason for any tendency of the motor to overheat, failure to start the load, or other abnormal symptoms. It is also frequently desirable to connect recording instruments in the motor circuit for other purposes, such as analyzing the output of the machine, as a check on the operator, or to gage processing operations.

Control circuits for many of the older induction motor installations were not provided with relay protection, and single-phase operation of polyphase induction motors on such circuits has frequently been responsible for motor burnouts. Usually this has resulted from the blowing of one of the fuses, while the motor is up to speed and under load. Under such conditions the portion of winding remaining in the circuit will endeavor to carry the load until it fails due to overheating.

The effect of increasing the load on the motor beyond its rated capacity is simply to increase the operating temperature, which shortens the life of the insulation. Momentary overloads usually do no damage; consequently the tendency to the thermal type of overload protection in present-day control. Obviously the ideal place to measure the thermal effect of overload is on the motor itself. This is readily effected through the use of a small thermostatic relay, usually applied in direct contact with the motor windings. This provides an effective protection against failure due to sustained overload.

Without doubt the polyphase induction motor is the simplest and most fool-proof piece of rotating electric apparatus that has been produced. The largest single cause of winding failures is probably due to the rotor rubbing the stator iron, usually because of worn bearings or complete failure of the bearings.

"When you getting your new glasses, Jimson?—You're reading that crack in the wall again!" (Courtesy Wheelco Instruments Company)

ANGLE IRON REINFORCED SCREEN SAFEGUARDS CRANEMEN

By P. C. ZIEMKE

DURING the recent war a great deal of equipment was hurriedly fabricated and installed to meet the ever increasing demands of the fighting forces. Cranes were no exception among the vast array of heavy machinery that had to *go in* before established deadlines, or some planner's face would be *red*.

Four of our 50-ton capacity bridge cranes arrived with a pair of serious exposures in the form of poorly planned ladderways and enclosures that brought the cranemen within inches of bare 460-volt conductors. The first hazard consisted of three feeder trolley wires that paralleled the inside edge of the bridge girder. These passed behind the crane cab entry ladder by a margin of one foot. Any misstep or wrong placement of the hands in entering or leaving the cab could readily have killed the crane operator. The second exposure occurred as the cab (suspended under the carriage) was run back to the wall where the main trolley feeders paralleled the crane-bay rail. Here the clearance was just eighteen inches from the operator as he stood at the controllers and faced into the bay. Should he casually lean back he would have himself pretty well grilled before help could reach him.

One inch mesh expanded metal was welded to a framework of $1\frac{1}{2}$ by $1\frac{1}{2}$ by $\frac{1}{8}$ inch angle iron and each point of exposure was covered by such a screen guard. These guards were arc welded or bolted in place as the occasion permitted. In some cases 2 by 2 by 3/16 inch bars served as additional stiffening.

A third such screen guard was placed adjacent to the fuse and contactor cabinet to prevent the operators from falling over the railing as they stood on a bench to work in the cabinet.

EXPANSION JOINT INSULATING METHOD CUTS DUCT MAINTENANCE HEADACHES

UNUSUAL application of mineral wool pipe insulation has been developed by engineers of Riley Stoker Corp. to insulate expansion joints on gas and air ducts. Eliminating cost of special fabrication of duct plate, the insulating method is designed for efficient, long-lasting service by minimizing the possibility of such maintenance headaches as surface cracks and hot spots, which can be costly in both wasted fuel and excessive repair time.

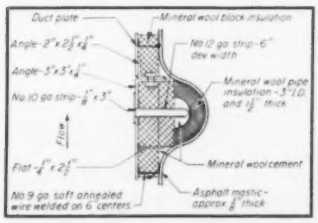


Fig. 1. Cross-section through duct expansion joint insulated by new method to prevent cracks and hot spots

Figure 1 shows the materials and construction of expansion joints around the entire perimeter of the duct. The actual gap in the duct plate, approximately 4 in. wide, is covered by two iron angles, welded as shown to one side of the duct plate. As the duct expands and contracts with changes in temperature, sliding occurs between the top edge of the 10 gage strip and the 3 by 3 by $\frac{1}{4}$-in. angle.

A gas-tight expansion joint is insured by continuous seal welding around the entire circumference of the duct at all points of attachment. The $\frac{1}{2}$-in. bolts secure the two angles at 24-in. intervals, except near the corners of the duct where spacing is reduced to 3-in. The heart of the expansion joint is two 6-in. strips of 12 gage sheet metal, which are formed and welded together at one end and, at the other end, to the respective edges of angle and duct at the expansion opening.

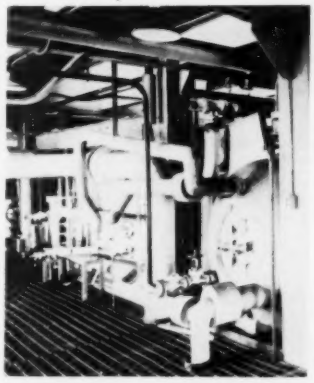


Fig. 2. At upper right, expansion joint, insulated by method of Fig. 1, in air duct supplying 660-F combustion air to burners of 75,000-lb-per-hr steam generating unit at Crookston plant of Otter Tail Power Co.

After all the metal work at the joint has been completed, two sections of mineral wool block insulation are cut out to fit directly under the pipe insulation between the 3 by 3 by $\frac{1}{4}$-in. angle and the $\frac{1}{4}$ by $2\frac{1}{2}$-in. flat. The thickness of the block insulation, both at the expansion joint and over the rest of the duct, depends on temperature of the air or gas and for most applications does not exceed 3-in. Molded-type mineral wool pipe insulation, 3-in. ID and $1\frac{1}{2}$-in. thick, is filled with insulating cement and installed as shown in 3-ft lengths around the duct.

The pipe insulation is secured in place by 1-in. galvanized wire mesh stretched over the insulation surface and wire-laced to 9-gage soft annealed wires welded to the duct plate on 6-in. centers. Adjacent block insulation is also secured by the welded wires, 14-gage lacing wire netting and 1-in. wire mesh. The insulation is finished with a $\frac{3}{16}$-in. thick layer of mineral wool insulating cement and a $\frac{1}{16}$-in. coat of asphalt mastic. The mastic may be sprayed with aluminum paint or, for indoor service, any casein paint.

Figure 2 shows an installation in which the pipe-and-block expansion joint insulating technique was used. This is the insulation of a secondary air duct at the Otter Tail Power Co., Crookston, Minn. The expansion joint can be seen on the right, following the contours of the large duct supplying 660 F air to the burners of a 75,000 lb-per-hr Riley steam generating unit.

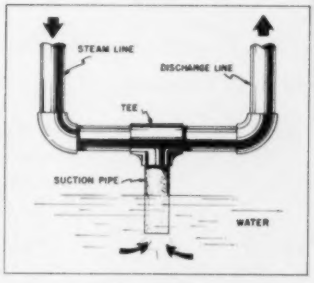
A HOMEMADE BLOW JET

By MICHAEL PORTER

A SATISFACTORY blow jet of high capacity can be made from materials usually available on the job.

If an inch steam line is to be used, obtain an inch tee, two short nipples, two elbows, one length of inch suction pipe, and enough inch pipe for the discharge line. Assemble these parts as shown in the illustration.

When ready to use, submerge the lower end of the suction pipe in the water before the steam is turned on. The tee should be near the water, but should not be submerged.



How to assemble parts and place in liquid

When sufficient steam pressure is turned on this jet, and if there are no leaks, the discharge line will deliver a full inch stream of water. Also, this jet is so simple that it is practically trouble free.

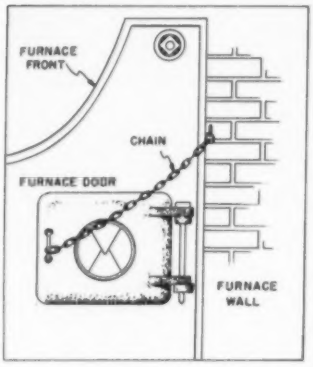
This type of blow jet is not as economical in the use of steam as factory made jets because there isn't a reducer of any sort to check the flow of steam. Possibly this could be regulated at the steam valve. Also, any increase thus gained in the discharge would be offset by a corresponding increase in the amount of steam used.

USE A CHAIN TO OPEN FURNACE DOORS

By CARL W. SMITH

WHERE furnaces are hand fired, firemen will find it an advantage to have chains attached to the furnace doors for quick opening. Procure a length of light chain and fasten one end securely to the free end of a furnace door, fastening the opposite end of the chain at any convenient point, after considering the direction the door will go in being opened.

When the fireman desires to open a door, he simply gives the chain a quick jerk instead of fumbling at the free end of the door with a scoop or poker. It may seem that the amount of time thus saved would not be worth the trouble of putting on the chains, but once on and in use, the fireman will not take them off because of the convenience they afford.

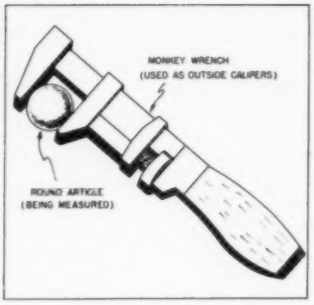


Schematic diagram showing how to connect chain

A MONKEY WRENCH USED AS OUTSIDE CALIPERS

By W. H. BONNARD

OFTEN it is desirable to measure round stock you are going to purchase, or make approximate comparative measurements of such material when you are away from the shop with perhaps nothing in your pocket except a rule. If a monkey wrench can be found, and one usually can be, approximate measurements can be made by measuring the distance between the wrench jaws with a rule, after the wrench has been used as outside calipers. If only comparative measurements are required to determine if two pieces of round stock have the same diameter, it will only be necessary to move the wrench from the first piece to the second, exercising care not to open or close the jaws while the wrench is being transferred. It is rarely practical to use wrench jaws as inside calipers, because where there is sufficient room for wrench manipulation, a straight rule might be used equally as well.



Monkey wrench being used to measure size of ball bearing

Wind Swayed the Big Stacks

– But They Bolted 'Em Down

By H. B. McDERMID

AT DUSK on a stormy winter day, just before quitting time, the master mechanic of a big power plant construction job came to his foreman handling the installation of auxiliary machinery with instructions to organize a gang for overtime work. The customer company's civil engineers had just reported that they had checked the sway of the two steel stacks that had just been erected. A full gale was blowing and their report showed that the stacks were swinging back-and-forth a good three feet at their tops.

The stacks were of good size. They stood 250 feet high above the power house roof and had a 16 foot internal diameter. The power house stood prominently on the extreme bank of the river which provided a cheap and plentiful supply of condenser water. The stacks were carried on heavy steel supports, extending from the roof some 70 feet down to the concrete floor of the boiler room.

The stacks were designed to be bolted by four inch standard vertically placed bolts to the steel work below — but the steel erectors had screwed on the nuts as far as they would go with their gloved hands and blithely left the job to be finished up by whoever happened to be handy.

The foreman, knowing what the job was, picked his gang accordingly. It was after dark when this gang reported for work.

The base of the stacks stood on their steel supports just below the roof and a good 70 feet above the firing floor of the boiler room with nothing on which to stand while tightening up the loose bolts. The roof girders were the only possible point of support, as the boss found when he crawled up in the darkness and checked as best he could. Clearly, the first requisite was light — so a hunt was started for the nearest electric outlet, which proved to be down at the floor. The boss crawled out again on the roof girders with a hand line and hauled up a temporary light lead, which when placed near the job, helped a lot. Then and only then would he let his men come up as he had an almost fanatical obsession that never would he command or even ask one of his men to go in any dangerous place until he himself had gone there first and proved that the danger was not too bad. At close range the job did not look too reassuring. The huge stacks were swinging and creaking in the gusts of a heavy gale — the boss remembered that he had seen the erection prints noting that the steel in these stacks weighed 800 tons each, with the brick linings weighing at least as much more — the whole swinging uncontrollably. It looked like a darn good place for his mother's favorite son to abandon with great speed. Instead he set about planning and placing an adequate hanging scaffold.

First, under his direction, the ground men sent up lines from the floor via the handline — next came 4 by 4's some eight feet long which were hung horizontally from the lower chords of the roof girders. Scaffold knots were made at the lower ends to make sure the 4 by 4's could not roll or twist under the men's feet. Next came wide two inch planks to be placed from one 4 by 4 ledger to another, forming a platform. Until the first set of planks were placed, the job was mighty ticklish, with sure death the penalty for a slip. But the men had full confidence in their leader and under his direction placed the material whenever possible by the use of handlines from the girders above, with the minimum of labor and danger.

After the first few planks were placed, the work progressed faster as the men had something much better to stand on and could move about much more freely. All the time, the heavy tonnage above was threshing about and creaking and squalling alarmingly.

When it came time for the wrench, the only one accessible was a 48-inch Stillson pipe wrench, which fortunately would open just enough to accept the flats of the four-inch nuts. But the men could not pull from the swaying scaffold and it had to be lashed in all directions horizontally to make a platform rigid enough so that the men could pull on the wrench effectively. Then it developed that all the power four men could exert on the wrench could not overcome the strain the gale was exerting on the stacks above. So, the gang had to watch for the lulls in the gusts and work frantically when the gale pressure was off. Finally, all the nuts were as tight as the men could get them using an extension handle on the wrench, made of a piece of pipe slipped over the wrench handle.

By midnight the nuts were deemed tight enough so the job was safe to leave. Next morning, the gang went over all the nuts again with the same wrench. This time they used a set of double rope blocks attached to the extension pipe handle. Soon after this treatment began the wrench gave up the struggle, so the boss ordered one made — a real honest-to-John open-end wrench for a standard four-inch nut. When the big blacksmith shop of the customer company had finished it, a hole was drilled at the balance of its weight as the wrench laid workwise. An eyebolt was placed in it so that a small tackle could be rigged to the wrench to hold it head high, where the nuts were located above the scaffold. Then a heavy ram was rigged on a rope at the convenient height and the gang really went to town on a first class tightening job. The latter part of the job, done in daylight, in moderate speed, was easy. However, the early part of the work, done in deep darkness at as high speed as men could work, with a gale doing its best to wreck the job, made a situation so dangerous that I would far rather look back at the successfully completed piece of work (which by the way was finished without the slightest injury to any man) than to again have it thrust upon me for an immediate solution, the quickest possible way, lest the forces of Nature beat me to it.

Tank Jackets Ease Oil Stock Handling

Mineral Wool Boards On Barge Tanks Keep Lube Oil Blending Stocks Warm En Route

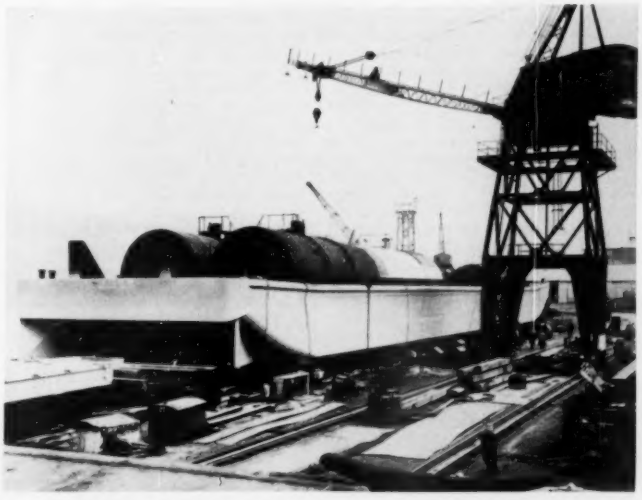
LUBRICATING oil blending stocks are very difficult to unload when at low temperatures and high viscosity. To speed unloading of oil stocks after a long trip in a tank barge, the oil temperature, usually above 110 F at the starting point, must not be allowed to drop excessively en route. Six cylindrical tanks (provision made for two more) on Lake Tankers Corporation's river barge LTC No. 39 are covered with 1½-in. thick mineral wool board insulation to insure a temperature drop of no more than 20 F for a six-day trip at 32 F average outside temperature.

The opening oil temperature at destination was as low as 65 F with the barge equipment previously used. It was almost always necessary to use shore steam to raise the oil temperature and lower viscosity. Specification of a 1½-in. thickness of mineral wool board insulation on the new tanks is based on a number of factors: (1) loading temperature, (2) unloading temperature (90 F as an approximate minimum), and (3) trip length and the outside temperature over the route the barge travels. As an added precaution against excessive temperature drops, the barge is also equipped with steam coils to distribute shore steam before unloading.

The 240-ft-long welded steel barge was designed by naval architects of the Dravo Corporation in cooperation with the Lake Tankers Corp. and was built at Dravo's Neville Island (Pittsburgh) Shipyard. Four tanks, 39.5-ft long and 16-ft in diameter, each have a capacity of 1400 barrels. The two larger tanks, 45.5-ft long and the same diameter, will have a capacity of 1600 barrels each.

To secure insulation on the curved tank surfaces, 2-in. long straight pins were welded to the tank on 18-in. centers. Then 24- by 48-in. mineral wool boards, 1½-in. thick, were impaled on the pins. To reduce and break up gaps between sections of insulation, the boards were butted tightly together and arranged in staggered rows.

Speed nuts were applied over enough pins to secure the sections of insulation temporarily. Black enameled bands were spaced around each tank on 18-in. centers between rows of pins and tightened with a banding tool. Expanded metal lath was laid over the insulating blocks



Oil tanks are partially insulated on LTC No. 39 standing in Dravo's Neville Island Shipyard. The white surface on one of the tanks shows the vinyl plastic coating before application of asphalt mastic

and secured by speed nuts over all pins.

On the flat surfaces of the tank, application was identical to that on curved surfaces except that the insulation was not banded. Metal lath was laid over the insulation and speed nuts installed. All surfaces were finished with (1) a thick vinyl plastic coating over a metal lath and (2) two coats of asphalt mastic. A cotton membrane was laid into the first mastic coat of two gallons per hundred square feet. A finish coat of mastic, four gallons per hundred square feet, was applied over the membrane to complete insulation.

Temperature measurements made by the Lake Tankers Corporation indicated the effectiveness of the insulation in keeping the oil warm from starting point to destination.

At near normal outdoor temperatures and short trips, the temperature drop from loading point to destination is negligible. For example, on a trip from Houston to New Orleans — 4 days at approximately 75 F outdoors — the loading temperature was 95 F and lost one degree in transit.

When You Have to Replace Diesel Piston Rings

By R. W. HOYT

Chief Engineer, Double Seal Ring Co.

You can cut costs by selecting the right types of rings . . . Why replacement is necessary . . . Tapered or out-of-round liners allow blow-by, a basic cause of many engine troubles . . . Advantages of self-sealing ring in stopping blow-by . . . Wearing of ring grooves and shoulder in groove . . . How to order new rings . . . Proper rings reduce lube oil consumption . . . Oil vapor, loss . . . How to use expanders

WHEN IS THE BEST TIME to change piston rings in your diesel engine? This is not a difficult question to answer because your engine will tell you in various ways if you know how to interpret the signs. Some of these signs are: 1) difficult starting, 2) power output below normal, 3) using too much fuel and/or oil, 4) suffering explosions in crankcase, 5) overheating, 6) making strange noises.

What causes these various difficulties? The answer to this is changes in the engine itself. Some examples of these changes are: 1) scoring or cracking of cylinder liners and pistons, 2) liner tapering, 3) variations in cylinder roundness, 4) shoulders worn in piston ring grooves, 5) wear in the rings themselves.

These facts can be summed up in an example where a piston, for example, is fitted with new compression rings. As the cylinder liner and ring faces wear, the end gap in each of the rings widens. This permits a more rapid rate of blow-by of compressed fuel vapors from the combustion chamber through the ring gap. Loss of this compression results in difficulty in engine starting, reduction of power and increase in fuel consumption. Burning fuel escaping through ring gaps destroys oil films on the piston rings and cylinder walls, making for poor lubrication and leaving carbon deposits. These deposits cause ring sticking, which in turn can lead to ring breaking and cylinder scoring. Destruction of lube oil films means that proper transfer of heat from the piston to the cylinder wall and thence to the cooling system for dissipation is interrupted. Overheating of the piston and rings means accelerated ring and cylinder wear.

How to Stop Blow-by

A frequent problem in considering replacement of rings in a tapered or out-of-round cylinder liner, is how to stop blow-by, the basic cause of a multitude of engine ills. One remedy for this problem is the use of self-sealing type compression rings such as the one shown surrounding the sub-title above.

This ring is designed so that the ring gap is fully sealed when the ring is in operation in either a new or worn cylinder. The tongue has sufficient spare length so that even as the ring expands to compensate for liner taper or wear to a seat in an out-of-round cylinder, the tongue continues to extend into its groove and provide a full seal against compression blow-by.

End gap in any ring increases at the rate of 3.1416 times the amount of wear (on the diameter) of the piston ring and/or cylinder wall. For example: 0.030 in. wear on diameter of ring or 0.030 in. taper in cylinder increases end gap an additional 0.094 in.

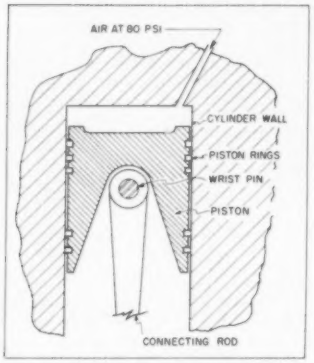


Fig. 1. Sketch showing setup for blow-by test

How can the rate of blow-by from the compression chamber be determined? Also, how great a rate of blow-by can be permitted? A good way to determine the rate of blow-by in a four-cycle engine is the compressed air test. This test is performed by closing the cylinder valves and applying 80 psi air pressure to the top of the piston. If the air pressure drops to zero in less than three seconds, the cylinder-piston assembly needs immediate attention — perhaps replacement or reboring of the cylinder; however, a new piston ring setup will often suffice to reduce the rate of blow-by to a tolerable level. When the rings are new and properly fitted it may take as long as 16 seconds for the pressure to drop to zero. This test is illustrated in Fig. 1.

If the rings are going to be replaced, an important factor should be considered. That is, wider rings may be needed in some grooves because of an increase in groove width. Experience has shown that perhaps half of all replacement rings are installed with improper side clearance, especially those in the top groove. Ring hammering against the grooved sides during engine operation causes wear of the sides.

Wear of the bottom side of the groove, the side most affected, often leaves a shoulder in the groove. This shoulder prevents a new ring from

Table Showing End Gap Increase Because of Ring and/or Cylinder Wear

	Normal end gap in straight cylinder	End gap after ring or cylinder wears 0.030 in.	End gap after ring or cylinder wears 0.060 in.	End gap after ring or cylinder wears 0.120 in.
5-in. dia ring	0.025 in.	0.119 in.	0.213 in.	0.402 in.
10-in. dia ring	0.050 in.	0.144 in.	0.238 in.	0.427 in.
15-in. dia ring	0.075 in.	0.169 in.	0.263 in.	0.452 in.

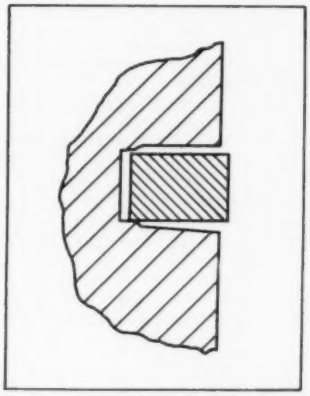


Fig. 2. Example showing shoulder wear and poorly seated ring

seating and operating efficiently. An example of poor ring seating is shown in Fig. 2. This sloppy ring fit allows the piston to hammer because it has room up and down to move. The top groove of an aluminum piston in a 4-cycle engine has been known to enlarge as much as 0.040 in. in a few months because of excessive side clearance.

For this reason, when shoulders or other surface irregularities are evident, or the grooves badly worn, the grooves should be machined out before new rings are installed. When this is done, it will be necessary to install wider rings than those removed. Before ordering the wider rings, an important step should be done first.

How to Order New Rings

The order for the new rings should specify the groove size in decimal figures. The ring manufacturer can then determine the proper side clearances and thus also the width of the rings needed. A cross-sectional sketch showing piston ring groove sizes, types and arrangement, as shown in Fig. 3, will also help the manufacturer do the best job of prescribing and making proper rings.

If the compression ring wears itself and the cylinder liner too rapidly, it is a good policy to replace it with a bronze-insert type of ring. Bronze has a much higher anti-friction value than the cast iron used in most rings.

Oil Rings

One of the main reasons for replacing rings is to cut down lube oil consumption. When oil rings fit properly they reduce excessive oil consumption and spread the lubricant properly on the cylinder walls. An average engine should have a minimum oil consumption rate of approximately one gallon per 3000 to 4000 horsepower hours.

The major factors affecting the ability of oil rings to control oil are: 1) type of ring, 2) number of rings per piston, 3) size of free gap, in rings, 4) ring scraping edge widths, 5) use of steel expanders behind oil rings, and 6) oil drain holes in the piston ring grooves or in lower lip of the grooves.

Size of the free gap in the oil ring which is the gap between the two ends of a ring when the ring is in an uncontained state is the major factor controlling the unit pressure of the ring face against the cylinder wall. The width of this gap is usually about ten per cent of the ring's diameter. The gap can be increased, however, when drastic control is wanted.

Another factor affecting unit pressure of an oil ring against the cylinder wall is the width of its scraping edge or edges. Installation of a new oil ring with a lesser edge width than, but with the same free gap as, the ring being replaced means that the area of the new ring in contact with the cylinder wall is less than that of the old. If ring tension is the same as before, the lb-per-sq-in. pressure of the ring against the cylinder wall is greater than before.

Oil Vapor Loss

A type of oil loss of which many operators seem unaware is the floating of oil vapor upward through the gaps of compression rings, into the combustion chamber and away with cylinder exhaust. A sealing type oil ring in the top oil groove can stop this leakage. This type of ring does this by blocking the gap as was mentioned in the part on the compression ring.

Expanders

Use of steel expanders behind oil rings can impart additional ring tension and unit pressure. The fact that many oil ring groove depths provide room enough only for the ring itself, however, limits use of expanders.

Extra Oil Ring

Recent tests have shown that an oil ring is needed above the wrist pin on four-cycle engine pistons which have ventilated oil rings. The reason for this is the fact that ventilated rings carry quite a lot of oil with them on the upstroke of the piston. Having gained momentum, on the upstroke, the oil tends to continue upward as the piston starts downward. This means some of the oil finds its way into the combustion chamber.

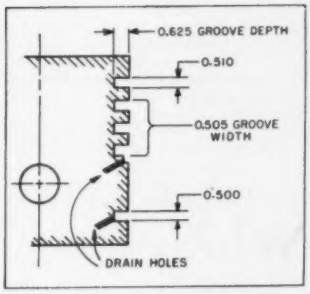


Fig. 3. Example of type of sketch to send ring manufacturer showing ring arrangement and groove sizes

A beveled and grooved ring that is unventilated in a groove above the wrist pin will help hold back this oil. The problem here is to find an extra groove in which to put this ring. A practical solution to this is to put the oil ring in the lowest compression ring groove. The compression ring usually in this groove can be removed in favor of the oil ring if sealing type compression rings are installed in the top two compression ring grooves. Two sealing rings will retain combustion chamber pressure better than three or four plain rings.

Give your engine a chance to develop the most kilowatts per dollar of operating and maintenance cost by putting in piston rings that are adapted to the peculiar condition in your own engine.

Common Varnish Troubles and Their Causes

THE following handy information is from the *Westinghouse Maintenance News*. Knowing what is wrong with a varnish job when something happens is important if you are to remedy the situation. Better yet, know what to do first to make the job come out satisfactorily. Here is some information that should help you —

1. **Lack of Drying**
   a. Applied in a cold, damp atmosphere. Moisture on surface inhibits evaporation of solvent and oxidation of drying oils.
   b. Temperature too low. Heat hardening resins require sufficient temperature to cause polymerization. Proper temperature expedites oxidation of drying oils.
   c. Insufficient baking time. Enough time must be allowed to permit complete polymerization or oxidation.
   d. Insufficient ventilation in oven. Sufficient ventilation and circulation of air is required to remove solvent vapors. Otherwise, these vapors, which are heavier

than air, will hang near bottom of oven and tend to resoften varnish on apparatus. It takes about twice as long to bake in an oven without air circulation as it does in a forced draft oven. At least 15 per cent of the circulated air should be by-passed to the outside of the oven to avoid explosive vapor concentrations. Regulate with by-pass damper.

2. **Livering or Settling of Varnish**
   a. Use of improper thinner — particularly where the improper thinner has lower solvency power than the required thinner. The two thinners will then tend to mix with each other, causing the solids to precipitate out.
   b. In the case of spirit varnishes, an excess of moisture in the alcohol. Water and alcohol have great affinity for each other. Shellac will tolerate very little water. Precipitation of shellac therefore takes place.
   c. Oxidation of varnish caused by standing in an open tank.
   d. Adding thinner too rapidly without sufficient agitation. Thinners mix with each other causing solids to precipitate.
   e. Adding too much thinner. This exceeds the dilution ratio where the dilution ratio is not infinite — resulting in what amounts to a saturated solution.
3. **Peeling, Cracking or Powdering Off**
   a. Baking at too high a temperature — thus exceeding the heat life of the varnish.
   b. Using a varnish having a very low oil content or too much drier.
4. **Streaking or Wrinkling**
   a. Applying second coat before first is thoroughly dry.
   b. Use of varnish which oxidizes too quickly, causing skin drying. Contraction of the skin then causes wrinkling.
5. **Throwing from Rotating Apparatus**
   a. Varnish insufficiently dried — thus throwing out uncured portions.
   b. Use of a varnish which softens at elevated temperatures.
   c. Pockets of wet varnish behind commutator. To avoid these pockets, it is advisable to dip, drain and bake with the pinion down, immersing only to the commutator.
   d. Use of varnish with insufficient adhesion, cohesion and hardness.
6. **Insufficient Binding Qualities**
   a. Low temperature or insufficient baking. Varnish is therefore still soft and insufficiently cured to attain maximum binding qualities.
   b. Use of a varnish which does not, due to its make-up, possess sufficient binding qualities.
   c. Varnish too thin. Therefore not enough mass.
7. **Improper Filling or Coloring**
   a. Varnish used too thin, causing excessive drainage or run-out.
   b. Dipping too hot, which thins down or reduces the viscosity of the varnish, causing excessive drainage.
   c. Not allowing apparatus to soak in varnish long enough. Apparatus should be allowed to soak at least until bubbling stops, indicating that air pockets have been eliminated. Even longer is better to allow varnish to soak into fibrous insulations.

Questions and Answers

Q & A—THE POWER ENGINEER'S FORUM—
HERE'S HOW IT WORKS

YOUR QUESTION about some problem in operation, maintenance or design will be published, signed only with your initials.

Answers to your questions from other readers will be sent you as soon as received, then published as space permits, so that all may have the information.

You, too, answer questions from other engineers in the same way. You get paid well for published answers and also get the credit for knowing them.

If other engineers help you solve your problem, you express your thanks, via the Q & A editor.

Simple, isn't it. And effective! Just ask engineers who have tried it!

Question No. 491

HOW HIGH CAN TURBINE EFFICIENCY GO?

WHAT is the highest possible over-all efficiency obtainable in a modern steam turbine, disregarding economic problems and using as many feedwater heaters as desired?

Detroit, Mich. T. D.

Question No. 492

SHOULD HE BUILD SEPARATE HEATING PLANTS?

WE have a power plant furnishing electricity, and steam for heating to the buildings on the campus of a large state university. The campus comprises some 50 different buildings spread over an area of 1½ square miles. Steam generated at 250 psi is supplied to two non-condensing turbogenerators, which operate at a back pressure of around 10 psi. This 10 psi steam is sent directly to the low-pressure heating lines. Steam is also extracted at 150 psi for use in the Mechanical Engineering Lab, and at 50 psi for distribution to various parts of the campus for kitchens and process work. The 50 psi steam is distributed through 10-in. lines. There has been considerable expansion of the college in recent years and this has been a challenge to the power engineering department to maintain proper heating service. Now, however, with the construction of two large buildings on the outskirts of the campus, we are confronted with the problem of supplying heating steam to these units. We still have sufficient steam generating capacity in the power plant but we find that our underground steam lines are reaching the limit of their capacity. Now the question arises, shall we install additional steam lines or would it be better to install individual heating plants at the new buildings. These will need low pressure steam for heating as well as 50 psi steam for process. If separate heating plants are installed, it probably will require additional manpower. We wonder whether any of the readers of POWER ENGINEERING can give us the benefit of their thoughts on this problem.

Chicago, Ill. W. H.

Answer No. 488

WHY USE STEAM TO OPERATE TURBINES?

(Continued from page 87)

since the low-temperature end of a practicable heat cycle is limited by the normal ambient temperature of the atmosphere or of water, this means that the temperature range available with a compressed air engine is very much smaller than is possible with the use of steam. Hence, the efficiency of

air-operated turbines or engines is correspondingly lower. Air-operated turbines and engines are used widely in compressed air tools, and also in submarine torpedos, but such machines are not thermally efficient.

Of course, in recent years we have done just what S. J. W. suggests, by developing the gas turbine, in which air is compressed, fuel is burned in it and the high-temperature gas-air mixture used to drive a turbine providing useful power. Moreover, we do use high-pressure water to drive hydraulic turbines. But with all this, steam has been used because, so far, it has been simpler and cheaper, in most cases.

These few comments barely touch upon the many aspects of the question but they reflect its profound nature. A full analysis would involve a comparison of the thermodynamic properties of air and water vapor, steam, and other gases, and also a knowledge of energy relations in various transformations of state. Indeed, the involved nature of the question is reflected in the interest it aroused among readers. Since the question appeared in the September issue we have been literally swamped with answers. Some of these have already been published; others, are presented here.

We cannot publish all the answers we have received but those shown below should be of interest to everybody with some knowledge of the fundamentals of steam engineering. In thinking about this question, just remember this: To change a pound of water at 212 F into a pound of steam at 212 F at atmospheric pressure requires the input of 971 Btu, almost 5½ times the amount of energy needed to raise the temperature of a pound of water from 32 F to 212 F. This is why steam is capable of carrying so much energy. This latent heat of vaporization, put into the steam in its conversion from the water state to the vapor state, is recovered when it condenses at the exhaust end of the engine or turbine.

It's the Energy, Not the Matter

S. J. W. ASKS why isn't it possible and practical to use high-pressure compressed air or high-pressure cold water, as well as high-pressure steam, to operate steam turbines. It appears to me that he fails to grasp the fact that it is not matter, or material substance, which turns the blades of a turbine, but rather the energy contained in the matter.

Sure, high pressure compressed air will turn a turbine. I have operated small air turbines used to turn drills, reamers, boiler tube cleaners, and so on. And high pressure cold water will turn a turbine, as witness the turning of Kaplan and other designs of turbines in the hydro plants.

But compressed air contains only the energy used to compress it, minus that lost as heat to the atmosphere or to cooling water, the so-called heat of compression. And cold water contains only the energy of position, that is, the ability to work when pulled to a lower level by gravity.

On the other hand, steam contains energy in the form of heat, the so-called lowest form of energy, and in great quantity to the pound of substance. This energy presence makes the steam elastic, and gives it the ability to do work and expend part of its energy during expansion. Other materials have this property; but steam possesses it to a very marked degree, due to its high specific heat.

Say, then, that the steam turbine is an instrument, or machine, for turning heat into motion. Since steam contains a high proportion of heat per pound, it is the substance which must be used to turn a steam turbine.

Oroville, Wash. O. L. BRAGE

Comments by Fitzpatrick

HIGH PRESSURE COMPRESSED AIR and water can be used as well as steam to operate turbines, but, the practical aspect of the first two mentioned power sources is eliminated by economic considerations in the power plant heat cycle.

After air had passed through turbine blading (with specially designed blades for air) it would have little after use other than powering hand tools, small turbine blowers and the limited air equipment found in a power plant, and the majority of this air would have to be exhausted to atmosphere.

Water flowing through a turbine would have little practical use for its motion anywhere in a power plant.

Overlooked in this proposal is the manner in which compressed air or water would be initially generated. Modern steam turbines operate on an efficiency of 9.25 to 9.87 lb steam per kwh. It would be uneconomical to use an electric motor to drive an air compressor which would power a turbine connected to a generator producing electricity.

Substituting a diesel engine in the cycle, it would again be loss motion to compress air: drive a turbine and generator, since the generating equipment could be directly coupled to the diesel engine.

An inherent difficulty in using compressed air is the danger of explosion. Several years ago, POWER ENGINEERING had a lengthy discussion of the dangers of compressed air in air transfer lines. At 100 lb psig, compressed air expands about eight times its compressed volume upon release to atmosphere. This discharge expansion through a turbine blading would cause a highly dangerous expansion and possible explosion.

Oil is constantly required to lubricate an air compressor and its cylinders. The compressed air stream carries some of this oil along with moisture. Since oil is highly inflammable in the presence of air, it would have to be constantly checked and removed from the system.

High pressure water offers the same difficulties as far as economics are concerned. A turbine waterwheel capable of producing 5,000 hp requires nearly 25,000 cubic feet of water flow each minute.

The mention of air as a prime mover is not a new thought in the matter. During 400 and 500 B.C. ancient man developed crude air compressing equipment and had uses for the limited amounts of compressed air so produced. The pagan priests took this air and performed "amazing rites" for the superstitious as to blowing out flames from a distance; blowing cloth draperies, etc.

Air developmental progress was slow until the middle of the 15th century when a series of bellows driven by cams, fastened to a waterwheel shaft, gave a sizable quantity of power.

During the 1700's Robert Boyle perfected the laws of gas compression and Sir Isaac Newton established our present laws of motion. Knowing the action of gases in general and motion, designers then concentrated on compressed air applications for industrial uses.

Air compression, based on these laws, then took great strides during the middle of the 17th century and large blowers powered by mules, water and even human beings, were developed for the forging and smelting infant steel industry.

James Watt took from 1768 to 1790 to develop his steam engine which has been called one of the most important and far reaching inventions of all time. The commercialization of this engine made possible the development of large amounts of power in one location so that factories employing power tools could be built.

Immediately steam power came to the front displacing air. Edison built his first New York Pearl Street power station in 1882. At that time electricity was a novelty and used solely for illumination purposes, as the electric motor, as we know it today, had not been fully perfected for power uses.

The steam engine was also still inefficient and some hardy air pioneers still refusing to quit took one last chance with air and experimented in powering via air, street cars in New York City during 1900. This was soon doomed to failure due to the numerous air pickup stations required and general mechanical inefficiency.

If Watt or some other inventor had never perfected the steam engine, air might be powering turbine type generators today; or waterwheels would dot our river banks to produce electricity.

L. W. FITZPATRICK
Jefferson City, Missouri

Answer No. 489

HOW CAN HE MEET SHORT PEAK STEAM DEMANDS?

INSTALLATION of a steam accumulator for a single 100 hp hrt boiler load swings would be very uneconomical.

In normal plant operation as steam load increases, boiler pressure drops slightly and additional steam is automatically flashed in the boiler, actually increasing boiler output.

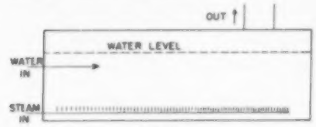


Fig. 1

As boiler pressure drops are undesirable, this quantity is limited and makes necessary a change in the fuel firing rate either automatically or manually to prevent loss of load.

A steam accumulator (Fig. 1) is a pressure vessel partially charged with water and designed to receive, condense and actually store steam during low plant demand and release this accumulated steam energy during peak demands. However, this pressure released is always lower than the initial boiler pressure since

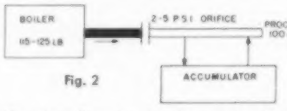


Fig. 2

the stored water in the accumulator is heated by boiler steam and brought to boiler pressure and saturation temperature.

In withdrawal from the accumulator, steam pressure is reduced, lowering the boiling point. A portion of the stored water-steam flashes to steam and the water temperature lowers to the boiling point of the reduced pressure. The sensible heat of the water converts to the latent heat of the steam.

The quantity of flashed steam thus depends upon the decrease in sensible heat per pound of water, water weight, and variable pressure heat of evaporation. The water content of the accumulator is always varying as it contains condensed steam from the boiler and its release on demand at a lower pressure.

Hence, to use an accumulator for 100 psig output, it is necessary to operate a boiler in the range of 120 psig. This will give the following calculations on the installation:

Enthalpy of saturated water
At 120 lb psig . . . . . 312.4 Btu per lb
At 100 lb psig . . . . . 298.4 Btu per lb
Difference . . . . . 14.0 Btu per lb

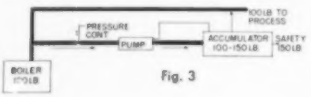


Fig. 3

The average latent heat of evaporation in this range is 883 Btu per lb. Saturated water at 120 psia has a specific volume of 0.0179 cu ft per lb giving 0.89 lb of steam available per cubic foot of water.

Another application of a steam accumulator is shown in Fig. 3. This actually compresses the steam and the 100 lb present boiler pressure guarantees 100 lb in the process line at all times.

Several other means are available, not using an accumulator, to secure more output from a boiler. Check firebox to see if it matches flame output and shape of oil-burner. Raise the maximum steam pressure to 125 lb or higher and install pressure reducing valves near the laundry equipment set at 100 lb.

Steam losses in the plant system can be reduced by better insulation efficiency. Proper water treatment and stabilization and elimination of water losses in plant will also increase output.

Adjust CO_2 for optimum rating for the particular boiler installation.

Check feedwater equipment for level control and leaks. Raising the feed-water temperature with supplementary firing and operating boiler at top pressure and installing reducing valve at each laundry unit will give more output.

Thoroughly check all steam traps and insulate steam returns. If feasible, install vacuum pump in return condensate lines to assure adequate and constant vacuum.

An accumulator however if installed, will assure firing boiler at constant rate and reduce required boiler capacity and will improve over-all combustion efficiency and fuel demands.

L. W. FITZPATRICK
Jefferson City, Missouri

Answer No. 490

WHAT CAUSED THE POINT ON STEAM ENGINE INDICATOR CARD?

Only Small Adjustments Needed, says Livingston

THERE ARE A FEW marine men here who have served their time on "up-and-downers." The general opinion is that the old twin Corliss is in very good shape. There is a little wire drawing through the inlet valve on the crank end, but not bad.

As to the high point on the head end, the compression pressure is a little high, which causes the pressure in the cylinder to be a little above that of the incoming steam. This can be corrected by closing the exhaust valve a little later in the stroke. However, the steam in both ends of the cylinder expands right down to practically the back pressure, so I would be inclined to leave things as they are. However, if O.H.D. wants to experiment to try to eliminate the point, I recommend that before doing so he carefully mark the present adjustment and return to it if he is unable to improve on it by altering the hook-up of his valve gear.

From the indicator card and data given, my figures work out as follows:

M.E.P., head end, 51.47 lb . . . . . I.H.P. 567
M.E.P., crank end, 51.76 lb . . . . . I.H.P. 530

I.H.P., one cylinder 1097

Assuming the same load for the other cylinder, the total I.H.P. for the engine is approximately 2200.

H. T. LIVINGSTON
Los Angeles, Calif.

Early Admission, says Miller

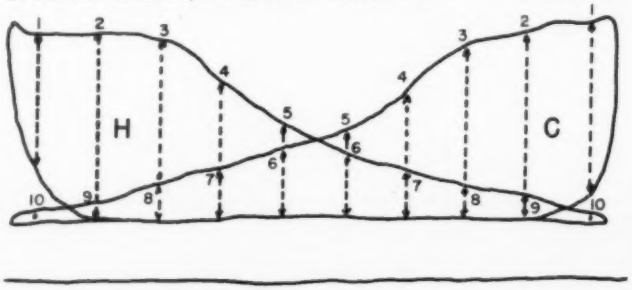
IT APPEARS that O. H. D.'s trouble is caused by early admission but as you say it is not too bad. An adjustment of the head end steam valve rod to give the valve just a little more lap will get rid of that point on the diagram. From the diagram I have made a step-by-step solution of the engine's indicated horsepower.

Mean ordinate—head end = 0.634 in.
Mean ordinate—crank end = 0.6625 in.
1.2965
1.2965 ÷ 2 = 0.648 (Ave. M. E. P.)
0.648 × 80 (spring) = 51.84 M.E.P.
34 × 34 (dia. piston) = 1156
0.7854 × 1156 = 907.9224 or 908 sq. in., area of piston, head end
9 × 9 (dia. rod) = 81
81 × 0.7854 = 63.6174 or 64 sq. in., area of piston rod
908 − 64 = 844 sq. in., area of piston, crank end
908 + 844 = 1752 $\quad \frac{1752}{2} = 876$ sq. in.
51.8 × 4 (stroke in ft) = 207.2
207.2 × 876 = 181507.2
181507.2 × 200 (strokes per min.) = 36301440.0

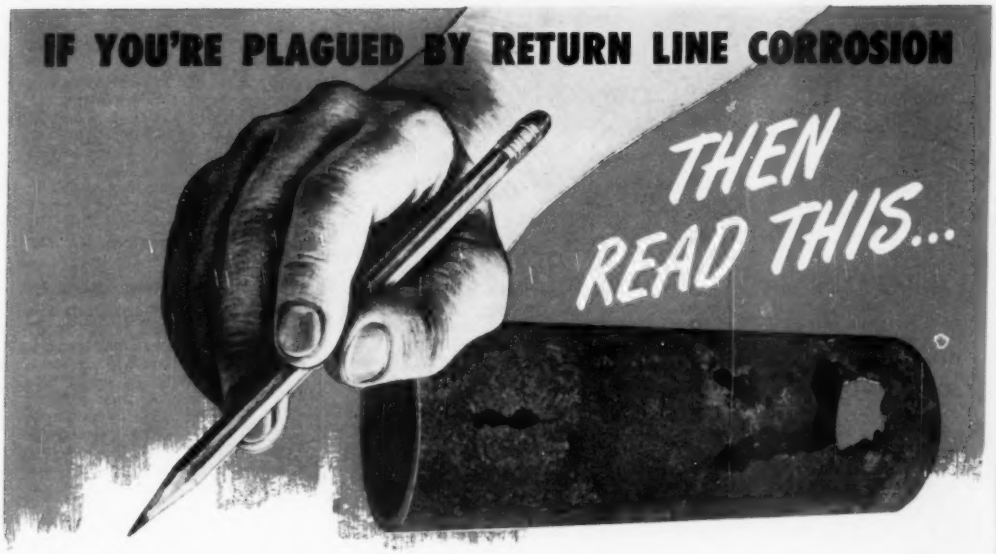
$\frac{36301440}{33000} = 1100$

1100 (IHP per unit of twin engine) × 2 = 2200 IHP total

Alton, Illinois L. B. MILLER



IF YOU'RE PLAGUED BY RETURN LINE CORROSION



As an engineer responsible for efficient, economical plant operation, you know only too well that corrosion of steam and condensate lines can send costs skyrocketing through pipe replacement, interrupted production, and increased labor and maintenance. Perhaps you, like many other engineers, have tried stop-gap methods to check the problem only to find them partially effective or far too costly.

Realizing the importance of this major industrial problem, Betz Laboratories has developed its patented filming amine treatment. Here, at last, is a simple, inexpensive, and practically 100% effective method of eliminating this costly and production-disrupting headache.

For example, a linoleum company, operating at 150 psi and producing 300,000 pounds of steam per day, employed sodium zeolite softening for a high bicarbonate raw water. The carbon dioxide content of the steam averaged 40 ppm. Continued maintenance was required due to failure of condensate lines from the steam kettles and unit heaters. After the filming amine treatment was applied, maintenance records showed an annual saving of approximately $8,000.00! And, a large part of this saving was obtained by eliminating weekend over-time work on pipe replacements.

Why not take the first step toward ridding your plant of corrosion *now?* Call in a Betz Engineer. Ask him to show you how Betz *Specialized* Water Conditioning Service can help you . . . quickly . . . economically . . . effectively. W. H. & L. D. BETZ, Gillingham & Worth Streets, Philadelphia 24, Pa. In Canada: Betz Laboratories Limited, Montreal 1.

See for yourself how Betz filming amine treatment eliminates return line corrosion and reduces operating costs. Send for Technical Bulletin No. 124.

BETZ

CONSULTANTS ON ALL WATER PROBLEMS

World's First "Supercharged" Generator at Edgewater

New principle, forcing cooling hydrogen directly over conductors of generator, claimed to reduce material by 30 to 40 per cent, for same output or raise generator ratings 70 per cent above those with standard hydrogen cooling methods, without increase in material

WORLD'S first "supercharged" generator has been installed at the Edgewater plant of the Wisconsin Power and Light Co. in Sheboygan, Wisc. This new design-rated 60,000-kw, 12,500-v, 3600-rpm steam-turbine-driven generator was built by Allis-Chalmers Mfg. Co. and is now in operation. It embodies a new principle that saves 30 to 40 per cent of the material of a normal 60,000-kw machine.

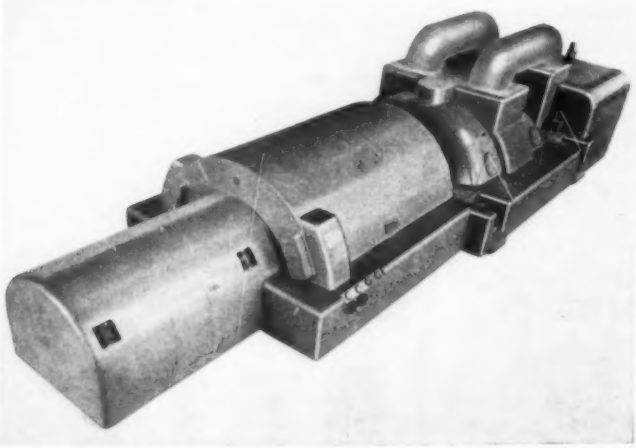
Great reduction in weight and length is achieved by forcing hydrogen, at much higher velocity than has been used before, directly over the surfaces of the current-carrying copper conductors of the rotor. In addition to the normal fans for circulating the hydrogen, the new generator has a two-stage centrifugal compressor, much like an oversize aircraft supercharger, mounted at one end of the rotor shaft supplying gas to the rotor.

To get the heat out of the rotor faster, engineers have devised specially-shaped copper windings through which cool hydrogen travels at high speed. After being heated in passing through the rotor, hydrogen is cooled by conventional water-to-hydrogen heat exchangers.

The heat-removing ability of the supercharged design is demonstrated by test data showing that, in less than 1/50 sec, hydrogen passes through the full length of the rotor passages of a 60,000-kw machine, while at the same time it absorbs enough heat to raise its temperature to 90 F.

In addition to the great savings in copper and steel effected by the new design, several other very important advantages are claimed. Powerhouses of the future will be smaller and less costly, it is stated, resulting from the shorter rotor and reduced rotor removal space required. Foundations will be simpler and reduced in size. Short circuit currents are substantially reduced, with consequent savings in cost of circuit breakers, reactors and other equipment and with less damage likely to occur in event of short circuit.

According to Allis-Chalmers engineers, the change from air to hydrogen cooling first introduced about 16 years ago, and now universally used on machines of this type, accomplished a 20 to 30 per cent boost in ratings for an equivalent frame size. By comparison, supercharged cooling in one step has raised generator ratings a further 70 per cent without any increase in amount of active material required.



View of world's first supercharged generator at Edgewater Plant, Wisconsin Power and Light Co., Sheboygan, Wisc. Unit rated at 60,000 kw, 3600 rpm, saves 30–40 per cent of material used in conventional machine

ASME MEETING

(Continued from page 83)

stations, Kanawha and Muskingum, now under construction on the AG & E System. Relation of plants to system and fuel supply are treated in detail. Each plant is to have two 200,000-kw turbine generators for 2000 psi, 1050 F, reheat to 1050 F, each supplied with steam by a single 1,335,000-lb-per-hr boiler fired by pulverized coal and designed for pressurized operation.

Performance of Modern Turbines

H. R. Reese and J. R. Carlson in a paper that revises and brings up to date the Steam Plant Planning Guide of 1945 gave data for performance of units up to 200,000 kw and steam conditions up to 2400 psig, 1100 F. These include throttle and condenser flow data; heater flows, initial pressure and temperature corrections, corrections for a number of feed heater stages, exhaust pressure and heat rates for reheat.

A method of comparing efficiencies of reheat and non-reheat turbine generators was given by C. W. Elston and P. H. Knowlton. This was based on test data from units actually in operation, emphasizing trends of the last 6 years. The test data are plotted as functions of "equivalent nozzle area", explained in the paper. Both 3600-rpm and 1800-rpm machines are covered; single-cylinder, tandem-compound and cross-compound non-reheat and reheat units are analyzed and end-packing loss taken into account, also exhaust loss and generator efficiency.

Cyclone Furnaces

Station design with cyclone-fired steam generators was covered by H. C. Schroeder and R. J. Strasser, while operating experiences with cyclone-fired steam generators were given by V. L. Stone and I. L. Wade.

The first paper gave the principal design characteristics of cyclone-fired units at Calumet, Waukegan, Fisk, Joliet, Michigan City, Edgewater and Ridgeland Stations, showed how the ash and fly ash distribution with cyclones compares with pulverized coal firing and how the cyclone units require less space.

The second paper gave details on the various cyclone units, methods of control, operating experiences with coal and with other fuels than Central Illinois coal. Maintenance experience is detailed, dust emission and boiler cleanliness discussed. Further details in future issues.

Gas Turbines

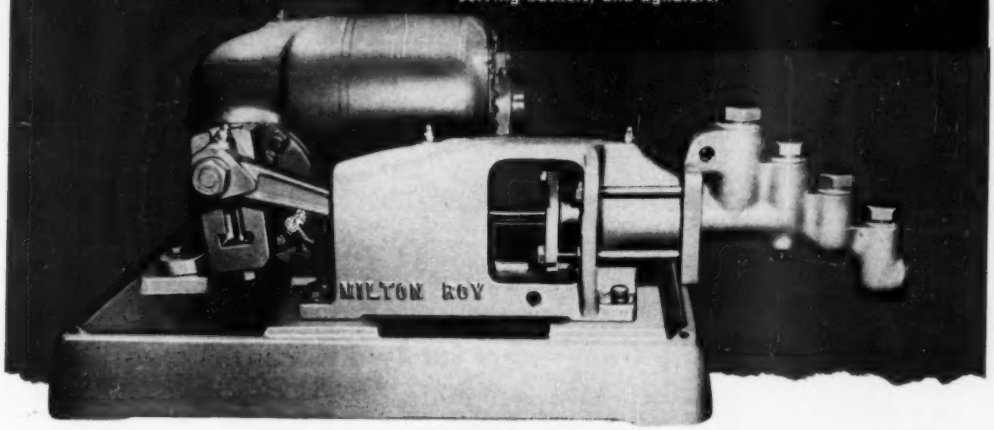
Many phases of gas turbines were discussed. Of special interest were designs of gas turbines for driving gas pipeline compressors, given by T. J. Putz. The operation of the 1800-hp gas turbine driven centrifugal compressor on the Mississippi River Fuel Corp. gas pipeline was

This is Controlled Volume Pumping

Boiler feed water treatment: Pumping 10.5 gph of 3% di-sodium phosphate at 1250 psi directly into the boiler drum. Pumping 2 gph of sodium sulfite at 100 psi into the storage space of the deaerating heater.

THIS MILTON ROY CONTROLLED VOLUME PUMP DOES THE JOB . . .

It's a Milton Roy Simplex, with a capacity range of 1 pint to 340 gph against pressures up to 5000 psi. At a large western power plant, four of these pumps—2 on standby service—do these things: precipitate calcium and magnesium salts, control alkalinity, prevent corrosion and embrittlement in the boiler drum. Residual dissolved oxygen is *scientifically* removed from the boiler feed water. One of many types of precision Milton Roy Controlled Volume Pumps, this particular unit was installed complete with chemical solution tanks, dissolving baskets, and agitators.



Boiler feed water treatment is an accepted application of the Milton Roy principle of controlled volume pumping. And Milton Roy Pumps have worldwide use in all phases of scientific treatment of boiler feed water—in all forms of internal and external chemical feed systems. Here are a few: metering of chemicals to the suction side of the boiler feed pump; introduction of chemicals directly to boiler drums; intermittent feeding followed by condensate flushing; automatic chemical injection in ratio to flow; automatic pH control; automatic control by conductivity.

These pumps give flawless service. They have the advantages of design simplicity, low upkeep, low cost.

For additional information on Milton Roy Controlled Volume Pumps for boiler water treatment: Call the Milton Roy representative listed in your classified telephone directory. Or write us direct.

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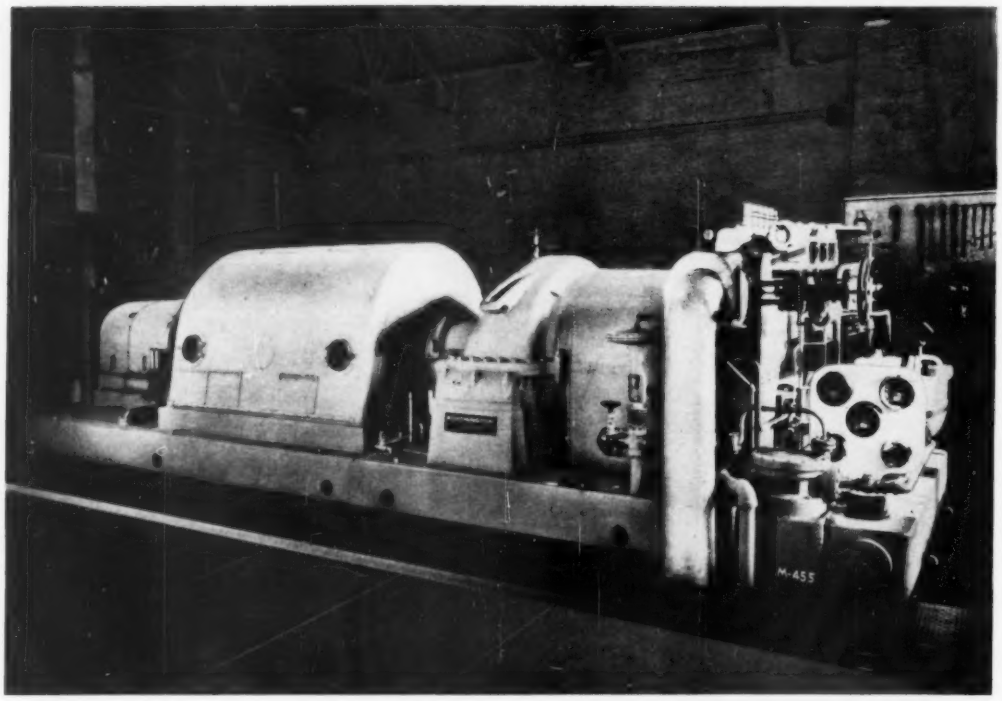


Power Planning—for the Years Ahead

Worthington Turbine Generators for Two Harbors Power Plant

This is how the City of Two Harbors, Minnesota met expanding power and light requirements and found the answer to economical power plant operation.

In 1948 the city installed a Worthington 2500-kw turbine generator. This machine operates in parallel with other units already installed in the power plant.

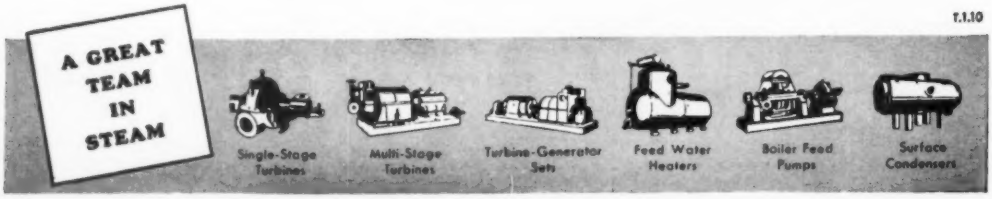
As the electrical demand grew, a survey showed that another power-producing unit was needed. Again, a Worthington turbine generator was selected. The new 3500-kw Worthington unit, to be installed next year, will supplement the existing power plant equipment. With this latest addition, the City of Two Harbors will be fully equipped to handle all its power and light needs for many years to come.

Worthington builds steam turbines in all types and sizes—and turbine-generator sets up to 10,000 kw. For proof *there's more worth in Worthington*, call our nearest office or write to Worthington Pump and Machinery Corporation, Steam Turbine Division, Wellsville, New York.

WORTHINGTON

STEAM TURBINE GENERATORS

T.1.10



described. It is now used at Farmington, Mo. to pack an underground gas storage field. A 5000-hp dual-shaft regenerative type unit for compressor drive is now being built for pipeline application.

Design features of a 5000-hp, 1-compressor, 2-turbine, gas turbine power plant were described by Bruce C. Buckland and Donald C. Berkey. This is a third type, intermediate in efficiency and complication between the simple open cycle machine and the compound regenerative type. This third type unit has an axial flow compressor driven by a h-p turbine. The compressor discharges through a regenerator to combustors heating the air for the h-p turbine. This exhausts to the l-p turbine driving the load and exhausting through the regenerator.

It can be used with or without the regenerator, applied to various arrangements involving both steam and gas turbine. Load speed can be over a wide range. The unit may be especially useful for gas-line pumping.

Operating experiences with a large number of foreign gas turbine installations, such as those in Switzerland, Peru, Egypt, Venezuela, France, Spain, and Romania, were given by Paul R. Sidler. Further details later.

Hydroelectric Developments

General trend in hydraulic turbine design, explained W. J. Rheingans, is toward reduction in weight and cost by welded steel plate construction and increased inlet velocities. Stainless steel and aluminum bronzes resist pitting and corrosion and reduce maintenance and outages. Self-lubricating bearings and carbon seal rings reduce maintenance. The reversible turbine presents interesting possibilities for pumped storage.

Runaway speed of Kaplan turbines was covered by G. H. Voaden and measurement of hydraulic turbine vibration by Parmakian and Jacobson.

Spreader Stokers

Of great interest to many engineers was the session on low load operation of spreader stokers, taking up overfire air, coal spread, excess air, reburning of cinder and fly ash, grate zoning use of ignition arches and so on.

C. H. Morrow explained how a boiler was arranged for gravity reinjection of fly ash on a spreader stoker and how the unit was tested.

Officers and Honors

R. J. S. Pigott was elected president of ASME for 1952, succeeding J. Calvin Brown. Following honors and awards were granted:

Undergraduate Student Award:—Philip Levine
Gantt Medal:—Thos. R. Jones
Hoover Medal:—Wm. L. Batt
John Fritz Medal:—E. G. Bailey
Pi Tau Sigma Gold Medal Award:—W. M. Rohsenow
Richards Memorial Award:—J. Kenneth Salisbury
Junior Award:—John D. Stanitz
Melville Prize Medal:—C. H. Barnard
Worcester Reed Warner Medal:—J. P. Den Hartog
Holley Medal:—George R. Fink
ASME Medal:—Glenn B. Warren

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"Inside Story"
on Darts...see how
Better Construction
makes them a
Better Buy
6 Ways!
Nothing beats high-test air-refined malleable iron for resisting stress and stretching. That's what the Dart body and nut are made of.
These non-corroding bronze seats are the heart of a Dart! Special oscillating grinders give them a true bearing surface. The joint is absolutely leakproof!
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One man can check

He needs only a handful of check weights!

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CALGON

a HAGAN RING BALANCE METER!

The check weight system for checking HAGAN *Ring Balance Meters is:*

★ **ACCURATE**—check the Hagan Ring Balance Meter under full static pressure.

★ **CONVENIENT**—a handful of check weights does the trick—no cumbersome equipment.

★ **TIME — AND MONEY-SAVING** — only one man is needed, and he can check the Hagan Meter in a very few minutes.

For information about Hagan Ring Balance Meters and how they can work for you, write to Hagan Corporation, Hagan Building, Pittsburgh 30, Pa.

The calibrated check weights supplied with each meter are stamped with the equivalent in inches of water differential. An easy calculation gives the relation between differential pressure and meter reading.

Here is all you do to check a Hagan Ring Balance Meter:

1. **Without closing the shutoff valves, simply equalize the lead lines**
2. **Check for zero**
3. **Put check weights on ring assembly**
4. **Read pointer or pen position.**

Checking the Hagan Meter minimizes meter outage time. Sounds easy? It's just as easy as it sounds.

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DIAPHRAGM CONTROL VALVES

AT WARREN PETROLEUM COMPANY'S big, ultra-modern Gladewater, Texas, gasoline plant, Climax valves and controls are standard — as these Type 86R fuel gas regulators.

Control of flow, liquid level, pressure and temperature is best achieved by BS&B's Type 86 Climax valves—whether the medium is air, gas, vapor liquid or steam. In any industries where trouble-free performance and ease of maintenance are important—Climax 86 valves have proved their reliability and versatility. BS&B Climax control valves feature wide range, high-lift, true-aligned, reversible inner valves, minimum hysteresis, chattering and shock. Bolted down yokes give added strength so valves can be installed in any position. Face-to-face dimensions of flanges are standard.

A Climax Type 86 is available to you for any control application—with single or double port, reversed topworks, single or double diaphragm, with hand wheels, finned cooling section, purged gland section, bellows stem packing, steam jacketed valve bodies and valve positioners. Pressure ranges are from 125 to 5000 psi; sizes range from ½" to 4" in single port, ½" to 16" in double port valves.

The superiority of Climax valves does not depend alone on their unique design—but on the exacting accuracy of their manufacture, accuracy that demands close tolerances for acceptance by BS&B's Climax Controls Engineers.

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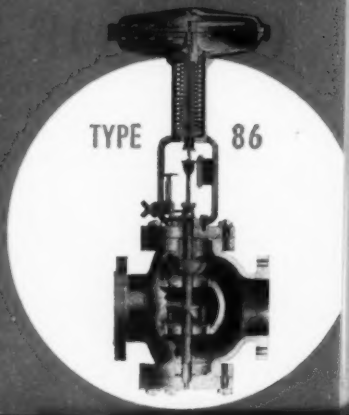

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New ENGINEERING BOOKS

District Heating Handbook; Third Edition; 530 pages; illustrated; size 6 by 9 in.; cloth binding; published by National District Heating Association; 827 N. Euclid Ave., Pittsburgh 6, Pa.; price $7.00.

The National District Heating Association is composed of public utility companies and others engaged in producing, distributing and selling district heating. The advancement of the art in recent years has been the result largely of the Association's influence in providing opportunity for interchange of information and ideas.

One of the most important means of doing this has been the District Heating Handbook, first published in 1921 to provide a working manual of practice. Later a Second Edition was issued and now this Third Edition has been completely rewritten to bring it up to date and at the same time retain the standards of authentic data and information representing established practices in the industry as a whole.

The book is of the most practical nature, giving specific numerical data, tables, diagrams on the practices actually used in the most modern district heating installations. The illustrations of equipment are all of the most practical type.

The book opens with a chapter on the growth and present status of the industry, then takes up the economics of district heating, then presents a section of general data, such as data on ventilation, climatic conditions, transmission losses through various materials, insulation data and the like. Chapter 4 describes the general design and maintenance of district heating plants. Next come chapters on water chemistry and corrosion, steam distribution systems in various cities, and discussion of general principles of steam distribution, and the equipment used therein.

There is a chapter on metering, a chapter on building heating systems and a good chapter on consumers' process equipment giving data on consumption of steam and hot water for various types of service. This includes a good discussion of many different methods of handling condensate.

Next are treated consumers' accessory equipment, estimating of steam requirements, economical use of steam, sales activities and hot water for district heating.

At the end of the book is a modern commercial equipment guide showing the equipment supplied by the various manufacturers in the field. In a pocket on the back cover is a large chart for pressure drops in piping transmitting steam.

Engineer-Custodians Manual, by Thomas J. Brett; Third Printing; 185 pages; size 5½ by 8½ in.; cloth binding; published by American Technical Society, Drexel Avenue at 58th St., Chicago 37, Ill.; price $2.50.

In this book the author, who is engineer custodian for the Board of Education of the City of Chicago, has assembled over 500 questions and answers on heating and ventilating, boilers and combustion, engines, pumps, electrical machinery, mechanics, plumbing and sanitation. This is supplemented by about 200 engineering formulas and tables

The book is intended for men such as building managers, engineer-custodians of public schools, firemen, caretakers and

(*Continued on page 116*)

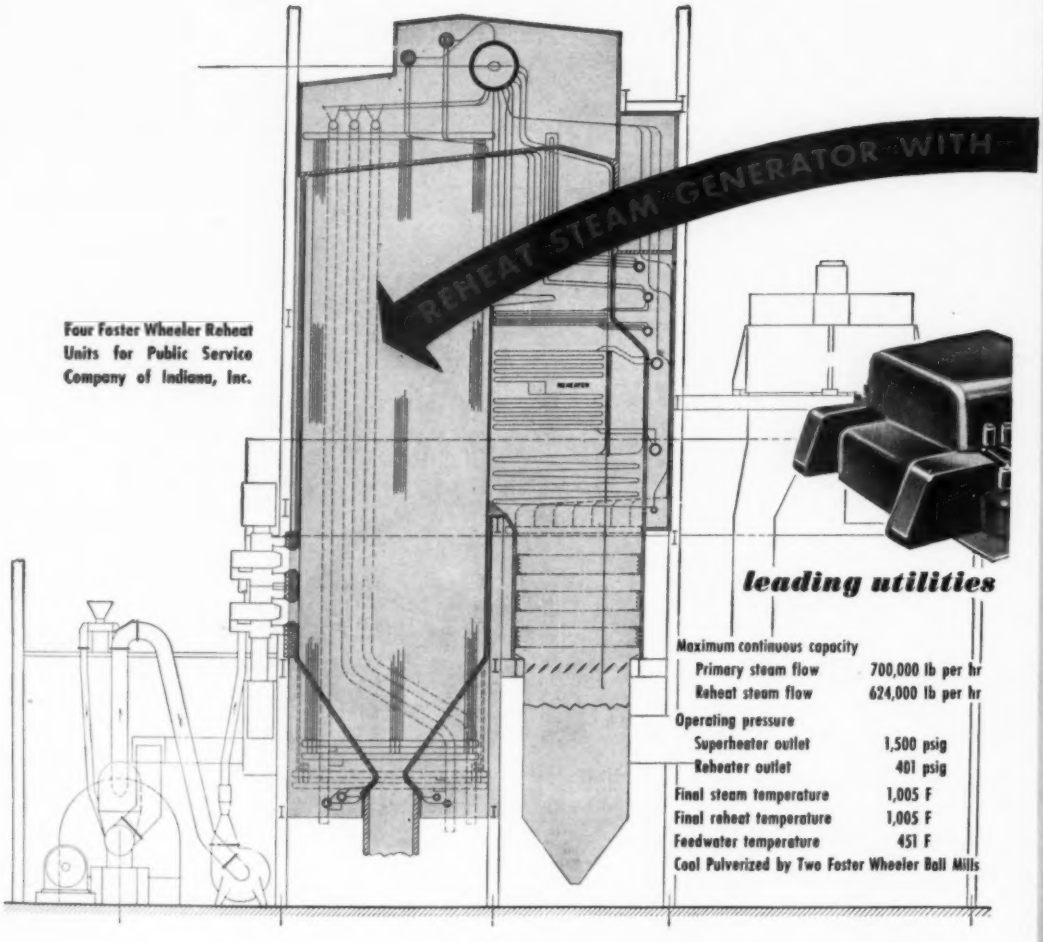
SPECIFICATIONS

2-pass, float-head, water-channel type; overall height of heater, 197"; shell diameter, 48"; greatest overall diameter, 64"; steam opening, 20"; steam pressure, 5 lbs.; water opening, 14"; copper tubes, 3/4" O.D., 18 B.W.G.; shell and heads of rolled steel plate.

This hefty heater is going into a jet engine plant designed by Albert Kahn, Inc., for a famous automobile manufacturer. Steam passing through 13,600 feet of tubing heats 4000 gallons of water a minute from 175° to 205°F., requiring 60,000,000 B.T.U.'s an hour. In meeting this customer's specific problem, Adsco engineers came up with exactly the right answer....With complete assurance, you can refer your heat exchanger questions, big or small, to Adsco, a leader in the industry for 75 years. Six branch offices and 37 manufacturer's agents throughout the United States. Write us.

AMERICAN DISTRICT STEAM COMPANY, INC.
NORTH TONAWANDA, N. Y.

Integrating

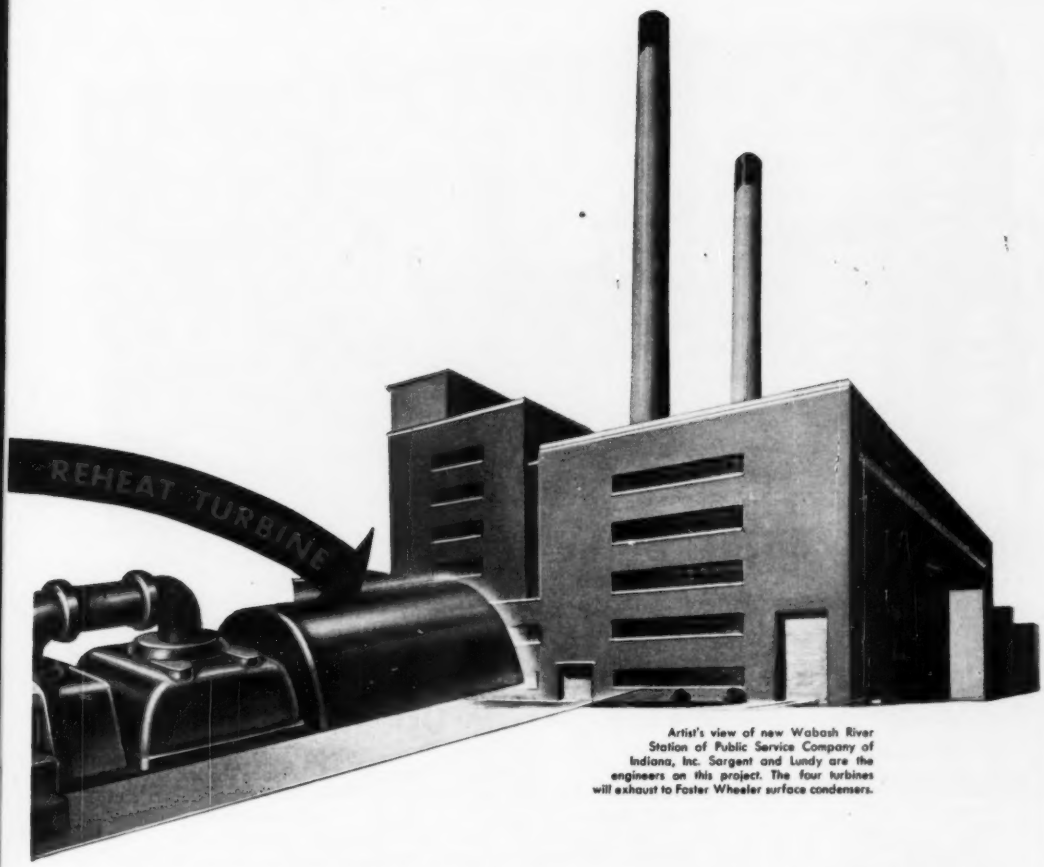


Four Foster Wheeler Reheat Units for Public Service Company of Indiana, Inc.

leading utilities

Maximum continuous capacity	
Primary steam flow	700,000 lb per hr
Reheat steam flow	624,000 lb per hr
Operating pressure	
Superheater outlet	1,500 psig
Reheater outlet	401 psig
Final steam temperature	1,005 F
Final reheat temperature	1,005 F
Feedwater temperature	451 F

Coal Pulverized by Two Foster Wheeler Ball Mills



Artist's view of new Wabash River Station of Public Service Company of Indiana, Inc. Sargent and Lundy are the engineers on this project. The four turbines will exhaust to Foster Wheeler surface condensers.

are ordering Foster Wheeler reheat steam generators

The large investment in present day power plant equipment dictates the careful selection of major components so as to avoid costly forced outages. Foster Wheeler engineers have always sought to refine the techniques of steam generation. They therefore took an early interest in the development of reheat where operating and control characteristics of the reheat boiler are integrated with those of the reheat turbine during every phase of service. Almost three decades ago, these engineers were responsible for the utilization of the characteristics of radiant and convection superheaters in series. Over "500 radiant superheater years" in one utility alone attest to the reliability of radiant surface for superheating.

The reheat steam generator illustrated is designed with a combination radiant and convection superheater and an all convection reheater. The chief advantages of this type of Foster Wheeler reheat steam generator may be listed as follows:

- complete freedom from furnace slagging is assured because furnace can be designed to suit fuel characteristics rather than reheat cycle duty requirements
- permissible wider selection of fuel of varying slagging characteristics
- location of the reheater deep in the convection zone assures safer metal temperatures during all starting, shutting down, and emergency operating conditions

This design also incorporates such features as:

- complete drainability of all superheating and reheating surfaces essential to quick and normal starts
- wide range of precise control of final steam temperature
- fully independent means of controlling primary and reheat steam temperatures.

These features provide for complete integrating of steam generating unit with turbine requirements under normal, quick start or emergency conditions.

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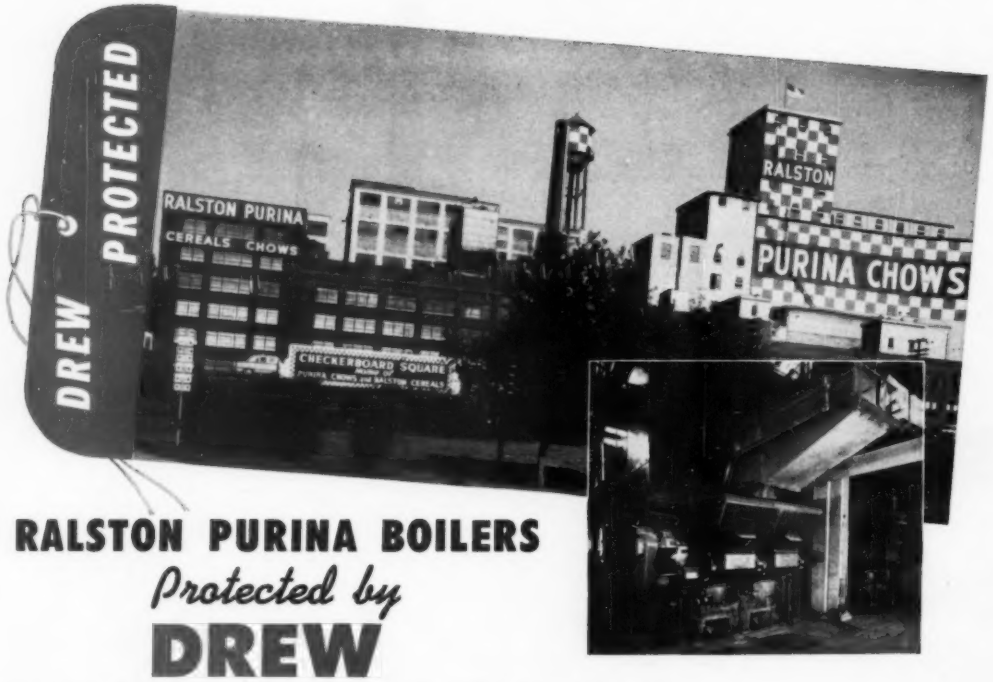

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This landmark on Checkerboard Square in St. Louis is the home office and original plant of Ralston Purina . . . famous Purina Chows and Ralston Cereals. A by-word in millions of homes and farms, Ralston Purina now operates 38 Chow plants across the United States.

Modern boiler water treatment plays an important role in this plant. Pure steam is essential for food processing and Drew complete BWT has protected the boilers for 5 years against steam contamination and other boiler water difficulties.

Many companies, like Ralston Purina, rely on the Drew 3-point program for better power plant operation.

1. Drew engineers make thorough studies of boiler plant operations and water conditions.
2. Drew water chemists and engineers analyze this data in Drew Laboratories and make specific recommendations for treatment.
3. Drew engineers make frequent tests in the plant to assure efficient performance of the water conditioning.

Thoroughness of investigation, proper treatment and frequent service have made Drew one of America's fastest growing water treatment companies. Industry's most respected names avail themselves of Drew Boiler Water Treatment and Service. Do the same. Consult the nearest Drew engineer or write for information.

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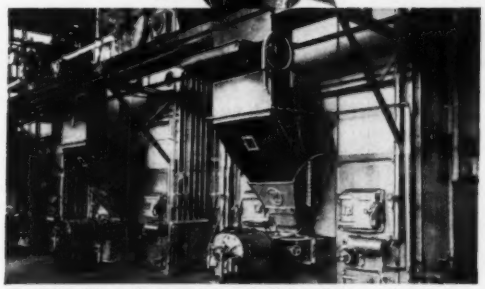
Nationwide Service in Boiler Water and Cooling Water Conditioning

"Orchids to Oppenheimer!

THAT NEW COAL HEATING SYSTEM HE DESIGNED SAVED $14,000 THE FIRST YEAR!"

says Carl R. Beckert, President, Thomas Young Orchids, Inc., Bound Brook, N. J.

"We're the largest orchid-growers in the world—Phil Oppenheimer is our consulting engineer. Had to have the most *dependable* heat we could find—steady, quickly available—to protect two million dollars' worth of orchid plants. Our new coal-fired plant gives us that kind of heat—in addition saved us $14,000 the first year! We've discovered that with modern equipment coal is as clean and automatic as any other fuel—and to do the job with oil would have meant an overall cost of 16% more! More than that, we can't take a chance on uncertain winter fuel deliveries. With *bituminous* coal we can store a year's fuel supply right on the ground."



The firing aisle at the new plant. This highly efficient coal equipment cut the company's fuel costs by 23%—is so completely automatic that it saved $6,000 the first year on labor costs, too!

This 300-ton silo that Young installed does away with former handling and shovelling costs. Coal is fed from the silo by a screw conveyor to each boiler's stoker-hopper—the coal is weighed on its trip.

- Use coal now? Get ALL coal's economy with highly efficient modern equipment. Building a new power plant? Find out how much more economical, efficient a job *bituminous* coal can do. Call in a competent consulting engineer. He can show you the modern coal-handling and combustion installations that will save most while meeting your particular needs. Remember you can count on *bituminous* coal! Of America's total fuel reserve—92% is coal! Even today oil is *imported*—while America can and does *export* coal! Ample coal reserves plus the outstanding efficiency of America's mining companies give coal users *the greatest possible assurance of a dependable fuel supply at stable prices.*

If you're running your own steam plant, here are just a few down-to-earth facts you can't afford to ignore!

COAL in most places is today's most economical fuel.

COAL resources in America are adequate for all needs—for hundreds of years to come.

COAL production in the U.S.A. is highly mechanized and by far the most efficient in the world.

COAL prices will therefore remain the most stable of all fuels.

COAL is the safest fuel to store and use.

COAL is the fuel that industry counts on more and more—for with modern combustion and handling equipment, the inherent advantages of well-prepared coal net even bigger savings.

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ARE YOU PACKING PUMPS

when you could be catching trout?

If you are spending your week-ends repacking pumps, you should repack with CHESTERTON "Parachute" Packing. Each ring is self-sealing and permits individual lubrication. The bottom ring has straight sides and can't roll in the stuffing box. CHESTERTON "Parachute" lasts longer, requires no attention, needs no gland pressure and adjusts itself automatically to retain full compression seal. No special adapters are required. This fully automatic packing can cut your packing costs in half at the same time it cuts your repacking time. Specify 600W for water, 600S for steam. 600HO for hot oil and 600CO for cold oil. Ask your distributor or send for full description of CHESTERTON "Parachute". *For longer, carefree week-ends, away from the job, Specify "Parachute".*

Chesterton *Parachute*
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☐ I would like more data on "600"
☐ Who is my local distributor?

Name _____
Company _____
Street _____
City _____ State _____

NEW ENGINEERING BOOKS

(Continued from page 111)

electricians. The author has had much practical experience of his own in these fields and has instructed many classes for those studying for competitive examinations.

The book is planned to be of aid to those taking civil service examinations. The questions have been taken from actual examinations and they are answered simply, yet when it is necessary to use formulas, the steps in solving them are shown. The main chapter divisions of the book are: Boilers and Combustion; Heating and Ventilating; Pumps; Engines; Plumbing; Electrical Problems; and a final chapter on weights of various materials, discussion of heat and motion, and handy facts and tables.

Books Published by American Technical Society, Drexel Avenue at 58th Street, Chicago 37, Ill. The following books, described briefly, are a few of the more recent issues of this outstanding publishing organization. Their catalog says that their books satisfy the needs of realistic education for schools, colleges and home study, and we can confirm this by personal examination and use of the books.

A feature of the books noted here is that each volume is accompanied by a study guide, usually 8½ by 11 in. in size, together with answer keys to practice problems. The whole plan is based on the idea that, while the books themselves are suitable for use as texts in classroom work, they can also be used for home study, and the guides and answers are intended to help in this endeavor. The books are written, so far as is possible, in the most practical style, explaining theoretical points by very clear diagrams and involving only the very minimum of mathematics for solution of problems.

Mathematics for Industry, by S. E. Rusinoff; 520 pages plus study guide; illustrated; size 6 by 9 in.; cloth binding; published by American Technical Society, Drexel Avenue at 58th St., Chicago 37, Ill.; price $5.50.

This book was developed to explain the mathematics that are absolutely needed in industry. At every point the author tries to show how each principle introduced has an ultimate application to a practical shop problem and he has selected the problems that experience has shown him are most frequently encountered.

An unusual feature is the chapter on engineering computations, which shows simple methods of figuring things that sometimes look a bit complicated.

The various chapters review first arithmetic, algebra, geometry, and trigonometry; then take up the calculations required in figuring screw threads and gears. There is then a chapter on logarithms, one on the slide rule and the final one on engineering computations. The latter shows how to figure force, work, power, horsepower, mechanical efficiency, cutting speeds for various tools, time for various operations and power required for cutting metal. There is an appendix of useful tables and the book is well indexed.

Logarithms Simplified, by Albert B. Carson; 165 pages plus study guide; size 5½ by 8½ in.; cloth binding; published by American Technical Society, Drexel Avenue at 58th St., Chicago 37, Ill.; price $3.00.

Logarithms are almost like magic in saving your time in figuring, provided you

know how to use them right. But you can't use them to their fullest capacity unless you know the reasons why certain mechanical methods of handling them must be employed. You will get along much faster with them when you learn the why right along with the how. That is what this book is intended to do for you. Once you learn how to handle logarithms you are pleasantly surprised at the increasing number of cases you find where you can use them effectively.

The book explains how, if you can add, subtract, multiply and divide decimals, you are qualified to read and understand logarithms. It tells how they were first developed, then explains positive and negative numbers. Next it shows formulas and equations, then shows how exponents are handled. Now you are ready for the definition of a logarithm, a discussion of how it acts, the parts of the logarithm called the characteristic and the mantissa and so on. Having learned how to handle logarithms in simple operations, you then go on to the next chapter, which gives practical applications of them. Tables of logarithms are included in the book and there is a good index. Answers to the practice problems are given in a separate supplement accompanying the book.

Applied Drawing and Sketching, by Joseph W. Fleming, Dewey F. Barich, and L. C. Smith; size 8½ by 11 in.; paper binding; 156 pages plus study guide; published by American Technical Society, Drexel Avenue at 58th St., Chicago 37, Ill; price $2.00.

The salient feature of this book is its down-to-earth application to the needs of everyday life. The book supplies the basic knowledge necessary for proper interpretation of drawings and also provides training to speed up progress in subsequent courses in drafting. It does not require the use of any drafting instruments.

The book discusses first where drawings can be used, then how to read drawings, next making pictorial drawings. There is a good chapter on basic lettering forms, and then the authors take up making working drawings, graphs and maps. Another chapter shows how to read machine shop and building trade blueprints and there is a final chapter on planning to show how designs should be worked out before attempting to construct a project. The illustrations are clear and cover a great variety of the practical problems met in elementary drawing of various kinds.

Petroleum Facts and Figures; Ninth Edition; 492 pages; 6 by 9 in.; paper binding; published by American Petroleum Institute, 50 West 50th St., New York 20, N. Y.; price $2.50.

This Ninth Edition brings up-to-date the figures on this vigorous and competitive industry covering both current facts and as many historical data as the records yield. This publication supersedes previous editions. Its purpose is to serve as an authoritative reference work for oil men, students, journalists, economists and all others who have an interest in petroleum. The book is divided into the following sections: 1 — Utilization; 2 — Production; 3 — Refining; 4 — Transportation; 5 — Marketing; 6 — Prices and Taxation; and 7 — General. There is a long chapter on the American Petroleum Institute Organization.

There is a classified cross-index, in addition to the regular index. This cross-index precedes each section and consists of a table of contents listing tables and page numbers.

The book presents the data mostly in tabular form showing, for example, U. S.

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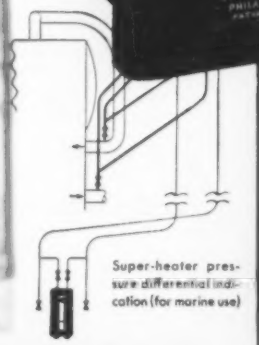
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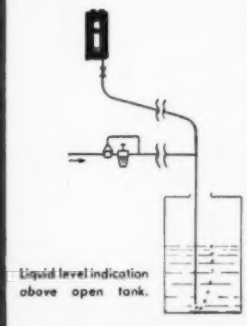
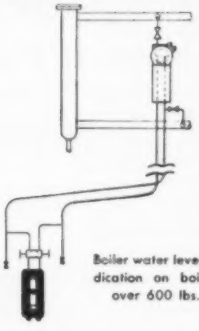
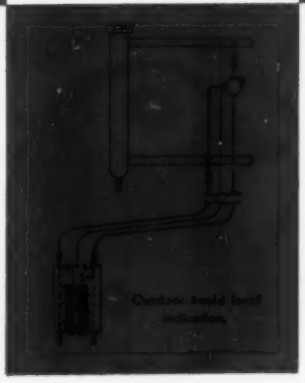
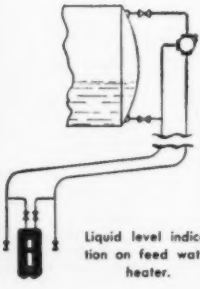

Liquid level indication above open tank.


Boiler water level indication on boilers over 600 lbs.




Liquid level indication on feed water heater.

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sales of residual fuel oils by states and uses from 1939 to 1949. Or, for another example, U. S. supply of and demand for petroleum wax, 1916 to 1949, in thousands of pounds. In fact, there is scarcely a phase of the production of petroleum products that is not covered by a table of some kind. The book is invaluable as a source of authoritative data on the entire petroleum industry.

Proceedings of the Air Pollution and Smoke Prevention Association of America, Inc., 43rd Annual Convention, 1950, Montreal, Canada; 122 pages; illustrated; size 8½ by 11 in.; paper binding; price $5.00.

The Association named above bears a new title but it was formerly the Smoke Prevention Association of America, Inc.

All the papers presented at its 1950 meeting have been assembled in this book. They are by consulting engineers, industry engineers, smoke inspectors, railroad engineers, equipment manufacturers and others.

The papers cover: railroad smoke control; how practical does the operating engineer find smoke ordinances; instrumention and procedures for smoke measurements; air pollution other than smoke; public relations in air pollution control; testing for fly-ash emission by the small steam plant; stock disposal of chemical waste; and many other related subjects.

Company Procedural Manual on Equipment Analysis, by William Kelly & Company; 46 pages; size 8½ by 11 in.; illustrated; cloth binding; published by William Kelly & Company, 120 S. LaSalle St., Chicago 3, Ill., or obtainable from Machinery & Allied Products Institute, 120 S. LaSalle Street, Chicago 3, Ill.

What is it costing you to operate economically dead equipment? The author of this book has been trying for some time to arouse industry to the importance of studying this question very carefully and has here worked out a scientific approach to re-equipment analysis for the buyer, for the seller, for professional engineers and for use as a college text.

The first three chapters are addressed to the policy-making executive, discussing what is wrong with present replacement practice and presenting an introduction to the MAPI formula and procedure, and the proper organization of equipment policy. The three final chapters discuss interesting applications of the formula as well as a simplified chart solution. The Manual is intended to show equipment users how to test and perfect their replacement practices by asking and answering a number of specific questions. Some basic equipment analysis forms are given, basic instructions are given for operational comparison and the book closes with some charts for applying the MAPI formula.

Mineral Wool Insulation Specifications & Standards, compiled by Industrial Mineral Wool Institute; illustrated; size 6 by 9 in.; flexible cover; published by the Industrial Mineral Wool Institute, 441 Lexington Ave., New York 17, N. Y.; price $3.20.

This practical handbook has just been published for buyers, engineers, plant superintendents, specification writers and contractors, as a guide in proper selection of material and application practices for government contracts and as a basis for specification within the industry itself. The Handbook includes 21 specifications and standards by four government agencies and the American Society for Testing Materials.

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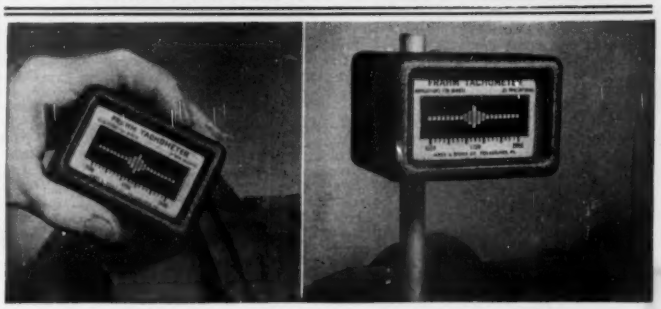

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Of the 15 specifications and standards by governmental agencies, seven are Federal Specifications approved by the Director of Procurement for the use of all departments and establishments of the Government. Three specifications are by the Navy Department and two by the U. S. Maritime Commission.

Of the six ASTM Specifications, three Tentative and two Proposed Specs previously have not been available to industry. The ASTM Specifications cover six types of industrial mineral wool insulation — mineral wool cement, batt, blanket, felt, and blanket-type and molded-type pipe insulation.

Barometric and Low Level Condensers — Standards of the Heat Exchange Institute; 24 pages; size 8½ by 11 in.; paper binding; illustrated; price $1.00; published by Heat Exchange Institute, 122 E. 42nd St., New York 17, N. Y.

This publication deals in detail with barometric and low level jet condensers. It gives first the standard nomenclature of these condensers, describes types and general design, then discusses condenser performance and condenser performance calculation. Data are then given on details of construction, amount of condensing water required by the various types, vacuum pump capacity, installation of condensers, use of atmospheric relief valves.

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HELPFUL BULLETINS

(*Continued from page 38*)

winding dissymmetries in motors, generators, transformers and coils. Thirteen advantages of the instrument are detailed, and its operation explained, specifications included. Illustrated with photos, schematic diagram, typical oscillograms. General Electric Co.

134 For Efficient Surge Protection — Bulletin 38-150 covers expulsion type lightning arresters for protecting distribution apparatus. Illustrates bottom and top series gap arresters, discusses their design, operation. Includes performance characteristics, dimensions, ratings, mounting suggestions. Switch-gear Apparatus Dept. Westinghouse Electric Corp.

135 Electronic Parts Book — Now ready is the 1952 edition of company's general ordering book. This 1100-pp catalog lists over 75,000 items and contains 7000 illustrations covering electronic tubes, panel meters and test instruments, relays, switches, condensers, resistors, transformers, plugs, jacks, connectors, wire, metal chassis and cabinets, voltage regulators, pilot light indicators, etc. Available to qualified power engineers, please state title when requesting catalog. Milo Radio & Electronics Corp.

136 Induction Frequency Converters — Publication GEA-5637 covers three-phase equipment in ratings from ¾ to 100 kw. Describes the fundamentals, operation and construction features of the high-frequency power supply apparatus, and includes application information, modifications, and limitations. General Electric Co.

137 On Fluorescent Ballasts — Booklet GEA-5731, 20 pp, explains in non-technical language how a fluorescent lamp works and the part the ballast plays in its operation. Illustrated with cartoons and diagrams, reviews role of ballast in modern fluorescent lighting. Of a more technical nature, Bulletin GEA-5672 deals with company's new system of "sound-rating" its ballasts. Describes how ballasts are classified according to amount of natural hum they emit. Table lists catalog numbers of ballasts according to sound ratings. State choice of booklets, or both. General Electric Co.

METALS

138 Data on Nickel Alloyed Cast Irons — Here's a 36-pp reference booklet giving the engineering properties and applications Ni-Resist. Describes eight types of austenitic nickel alloy cast irons that offer unusual combinations of properties. Applications and comparative service data in many industrial fields are presented to prove its utility in withstanding corrosion, heat, wear and low temperature. Illustrated with photos, contains tables of properties, corrosion data. The International Nickel Co., Inc.

139 Copper-Base Alloys — This folder lists 65 commonly used brass and copper alloys, along with their composition, properties, forms and typical uses. It is compiled to aid in distinguishing between the many copper base alloys referred to as brass, each of which has differences and particular advantages. Bridgeport Brass Co.

140 Nickel Bibliography — List B is company's latest compilation of available bulletins on nickel and nickel alloys. Covers general articles on these alloys, also publications dealing with their properties, and corrosion resistance, or offering working instructions. Bulletins concerning use of nickel alloys in chemical, electrical, food processing, petroleum, power, paper, other industries described. The International Nickel Co., Inc.

141 Expanded Metal Meshes — Profusely illustrated and telling the story of expanded metal and its uses in detail, Catalog 493EM, 28 pp, is an excellent source of information. Pitched on the theme of "how to make a little metal go a long way," catalog shows many uses for this product, suggests others. Emphasis is placed on saving steel and other critical metals while saving

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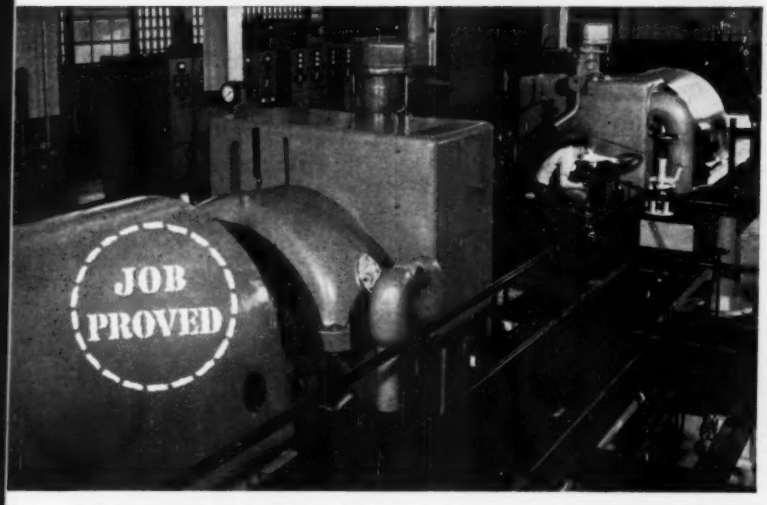

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S32 ROTOJET Junior Air-driven Motor, cone cutter, universal joint.

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weight, allowing for free passage of light and air, permitting flexibility of construction. Penn Metal Co., Inc.

142 Alloy Study — Technical Bulletin T-32, 22 pp, combines graphs, tables, photos and text to present a highly informative booklet on engineering properties of Duranickel. Some of the topics given consideration are working characteristics, thermal treatment, corrosion resistance and applications. A brief comparison between Permanickel and Duranickel included. The International Nickel Co. Inc.

143 Steel and Alloy Plate Fabrication — This 8-pp bulletin shows company's engineering and fabricating facilities for a wide variety of tanks, kettles, towers, reactors. Describes facilities for shearing, forming, fitting and welding to meet ASME and API-ASME codes. Tables and charts outline maximum dimensions handled, also range of plate thicknesses in various alloys along with test pressures. The Colonial Iron Works Co.

WATER CONDITIONING

145 Conditioning by Catalysis — How company's catalytic treatment functions to eliminate scale and corrosion in boilers, hot and cold circulating systems for potable and industrial water, is explained in this 6-pp bulletin. Gives tips on installing and servicing required apparatus, and how to select correct model. Application of this process to 10 common water treatment problems is described. Sola Catalytic Co.

146 Chemical Descaling — This bulletin stresses the advantages of a chemical service for cleaning and descaling of industrial heat exchanger equipment and shows before and after photos of jobs handled. Lists types of equipment to which service is applicable, discusses efficiency of inhibitors used. Solvent Service, Inc.

147 Feedwater Treatment — Here is a 10-pp illustrated report on boiler feedwater treatment for a high-pressure, high-makeup power and steam producing plant. It is based on studies to determine best method of meeting requirements for both the high-pressure steam used in power generating turbines and the district heating steam for downtown Philadelphia. Reasons for deciding on a demineralizing plant are explained, together with studies of demineralizing systems and cation and anion exchangers from which selection was made. Equipment installed and operating results are explained. Graver Water Conditioning Co.

STEAM GENERATION

148 Packaged Steam Generators — This new 16-pp booklet on steam generators is profusely illustrated in color, providing photos, cut-away and schematic drawings and describing in detail the construction and operating principles. Although written for engineers, its explanations of induced draft, dry steam, four-pass down-draft design, 5 sq ft of heating surface per Bhp, flexibility of operation, and oil, gas, and combination gas-oil burning equipment will interest all concerned with selection of such equipment. Superior Combustion Industries, Inc.

149 Packaged Boilers — Packaged boiler units with capacities ranging from 4100 to 23,500 lb of steam per hour are presented in Form WT-6R, 6 pp. Special features of these easily installed units are described briefly. Both moderate and higher capacity types are illustrated. Specifications included. Wm. Bros Boiler & Mfg. Co.

150 How Much for Steam — Here's a "slide rule" calculator for computing steam costs. It's pocket-sized, shows how to find the comparative steam costs per 1000 lb, using coal, oil or gas, and is based on fuel costs of price per ton, per gallon and per cubic foot. The calculator takes into account the efficiency of the system. On its reverse side is an easily-used slide showing company's boiler horsepower, lb of steam per hour, output, fuel consumption. Please state title when requesting calculator. Cleaver-Brooks Co.

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151 **Steam Generators** — Bulletin 1218 on company's Powermaster units for steam or hot water use. Describes high or low pressure units from 15 to 500 hp. Gives details on burner design and quick changeover from oil to gas firing in minutes. Orr & Sembower, Inc.

LUBRICATION

152 **Planned Lubrication** — Twenty-pp Bulletin BK-19 gives full details on seven of company's specialized lubricants that cover most plant requirements. Information includes lubricant characteristics, benefits, uses, densities, specifications and container sizes. Covers lubricants for ball and roller bearings, plain and ring bearings, open gears, enclosed gears, speed reducers; also oils for cleaning, loosening and penetrating. Keystone Lubricating Co.

153 **For High-Temp Lubrication** — This 8-pp booklet on synthetic lubricants describes their properties and advantages for high-temperature applications. How to use these non-sludging lubricants in ovenchains and drives; glass machinery, as well as heavy-loaded gears, bearings, and speed reducers operating at high temperatures is presented. Carbide and Carbon Chemicals Co., Union Carbide and Carbon Corp.

154 **Industrial Lubricants** — Bulletin 93 provides 8 pp of case histories on the successful use of Molykote in such applications as threaded connections, press fittings, extreme temperature lubrication, instruments. The Alpha Cor,p.

MECHANICAL POWER TRANSMISSION

155 **Double-Pitch Roller Chains** — Bulletin 51-2, 12 pp, explains how these double-pitch chains can often effect both cost and weight reductions in drives and conveyors. Charts, photos, diagrams and tables show in detail both drive and conveyor types and standard attachments available. Baldwin-Duckworth Div., Chain Belt Co.

156 **D-C Motor Brake** — Bulletin 1004-E, 8 pp, discusses features of the Type WB brake described as radically different from most brakes. Torque rating and dimensional tables are included along with installation photos. The Electric Controller & Mfg. Co.

COOLING

157 **Atmospheric Sections** — This illustrated bulletin gives general specifications and construction details on atmospheric sections for use where water serves as cooling medium. Units described are for vertical or horizontal mounting, under cooling tower or submerged in water. Hudson Engineering Corp.

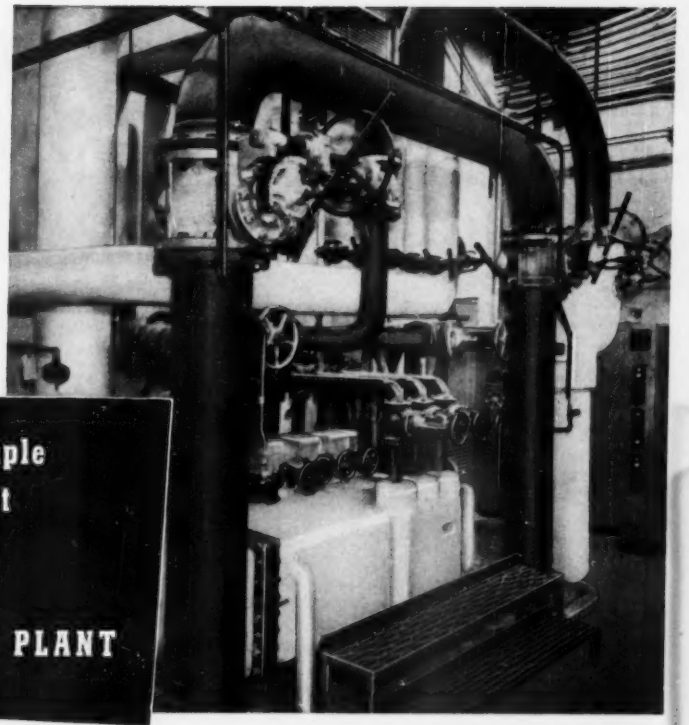
158 **Heat Exchanger** — Bulletin 120 features company's Aero heat exchanger which uses air as cooling medium, stressing economy of operation. A large cutaway illustration shows how exchanger works, diagrams show cooling and heating cycles. Some of the many uses for this unit are listed. Niagara Blower Co.

159 **Steam Operated Water Chiller** — This 8-pp illustrated booklet introduces a 25-t, absorption type water chiller which uses steam as its source of energy, water as a refrigerant. Advantages of the unit — its economy, flexibility, range of applications — are discussed. Servel, Inc.

AIR CONDITIONING, DUST CONTROL

160 **If It's Done with Air** — Sixteen-pp Booklet B-5164 is a condensed catalog on manufacturer's equipment for air conditioning, air handling and air cleaning. Unit air conditioners, unit heaters, hermetically sealed compressors and condensers and water coolers are described. What this equipment consists of, its features and specifications are included. The air handling apparatus section includes ventilating equipment,

CONSECO



How CONSECO Triple Element Steam Jet Air Ejectors Help Trim Costs at . . . HARBOR STEAM PLANT

THESE triple element, two-stage Conseco Air Ejectors constitute parts of units No. 3, 4 and 5 which are installed in the Harbor Steam Plant, Los Angeles, California. Each ejector operates with steam at 400 psig, 850 deg. FTT and serves a twin 70,000 sq. ft. Conseco Condenser handling a 75,000 kw turbine

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It uses Niagara No-Frost Liquid Spray to keep frost and ice from ever forming. It gives you, automatically, refrigeration with no defrosting, and full capacity NEVER cut down by ice building up progressively on refrigeration coils.

Now, a NEW design No-Frost Liquid concentrator, using a new principle, takes away moisture as fast as it is condensed by evaporating it at low temperature — not boiling it away at high temperature. It has 14 times the capacity of the old method per dollar of investment — one concentrator will handle a battery of high capacity spray coolers.

This gives you more refrigeration at lower cost; less machinery in less space. You operate at high suction pressure, saving power and wear and tear on compressors.

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You get true trouble-free refrigeration . . . No brine . . . no salt solution . . . no dirt . . . no mess . . . It is entirely clean; you get rid of dirt and odors. You reduce both equipment and operating costs.

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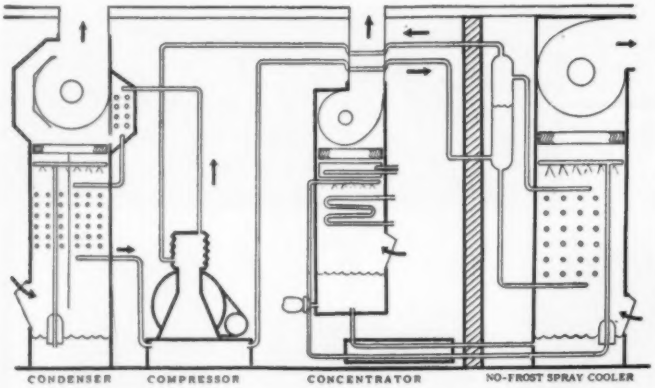

A simple method, easily maintained. Saves a third of your refrigeration cost. Ask for Niagara Bulletins 118 and 119.

air conditioning equipment, heating equipment, fans, providing specifications and capacity data. Company's Precipitron, its principle of operation, horizontal and vertical air cleaners, and an oil mist control unit are also covered. Sturtevant Div., Westinghouse Electric Corp.

161 Industrial Dust Recovery — Catalog 101, "The Collection and Recovery of Industrial Dusts," 28 pp, offers a practical approach to dust recovery and provides excellent material for selection of dust collecting equipment. Explains what dust is and what should influence choice of equipment for handling it. Equipment described includes cyclone units, electric precipitators, low resistance and low draft loss collectors, combination mechanical and electrical systems, special purpose units and hopper valves. Buell Engineering Co., Inc.

OTHER EQUIPMENT

162 Draft Inducers — How to provide adequate, uniform draft without use of high stacks is told in Bulletin I-51, along with other advantages of company's draft inducer. Several installations are pictured. L. J. Wing Mfg. Co.

163 Restoration of Transformer Oil — This is a 4-pp illustrated case history covering use of company's purification unit by a west coast power company in reconditioning deteriorated insulating oils. Explains cycle of operation, includes test results on quality of finished oil. Honan-Crane Corp.

164 For Fine Diffusion — Bulletin 6530 describes company's Colaflex diffuser, a flexible collapsible unit for maintaining practically constant permeability for fine diffusion of air or gas in sewage and industrial waste treatment, water conditioning, absorption processes. Tells how diffuser works, how it is cleaned. Infilco Inc.

165 Steam Turbine Generator — Design and construction features of company's WA series steam turbine generator units in NEMA ratings of 2000 to 7500 kw are described in 8 pp Bulletin 03B7654. The WA series units are built in the condensing type, for power generation only, and in non-condensing and automatic extraction types to provide a steam-power balance where process steam is used. Cross section views show each. Allis-Chalmers Mfg. Co.

166 Oil and Combination Burners — Providing a discussion of the efficiency and economy of manufacturer's oil burner, this 16-pp illustrated booklet also discusses oil as a fuel alone, or in combination with gas, the dry atomization principle, and the separate unit construction of the burners. Two basic types of burners are described. Lammert & Mann Co.

167 Let's Keep It Quiet — Catalog 108, 4 pp, describes and pictures an air-cushioned vibrator designed to move, settle or package material quietly and described as especially suited for applications where noise is a factor. Includes dimensions, installation tips. The Cleveland Vibrator Co.

168 Improved Refractory Coating — This illustrated bulletin describes Cera-Kote, a refractory coating made from ceramic and metallic materials and said to make good refractories last longer and serve better. Cites test results covering hot load strength, shrinkage, coal slag. Williston & Co.

169 Modern Ash Handling — Four installations of modern ash handling equipment are pictured and described briefly in this bulletin. These include jetting-pumping-pneumatic and completely pneumatic systems in use at central stations, and industrial power plants. Allen-Sherman-Hoff.

170 Piston Ring Reference Book — This 20-pp catalog describes and pictures company's entire line of piston rings, giving application suggestions for each type, discussing design and other advantages, listing sizes, weights. Also provides operating data, tables. Safety Seal Piston Ring Co.

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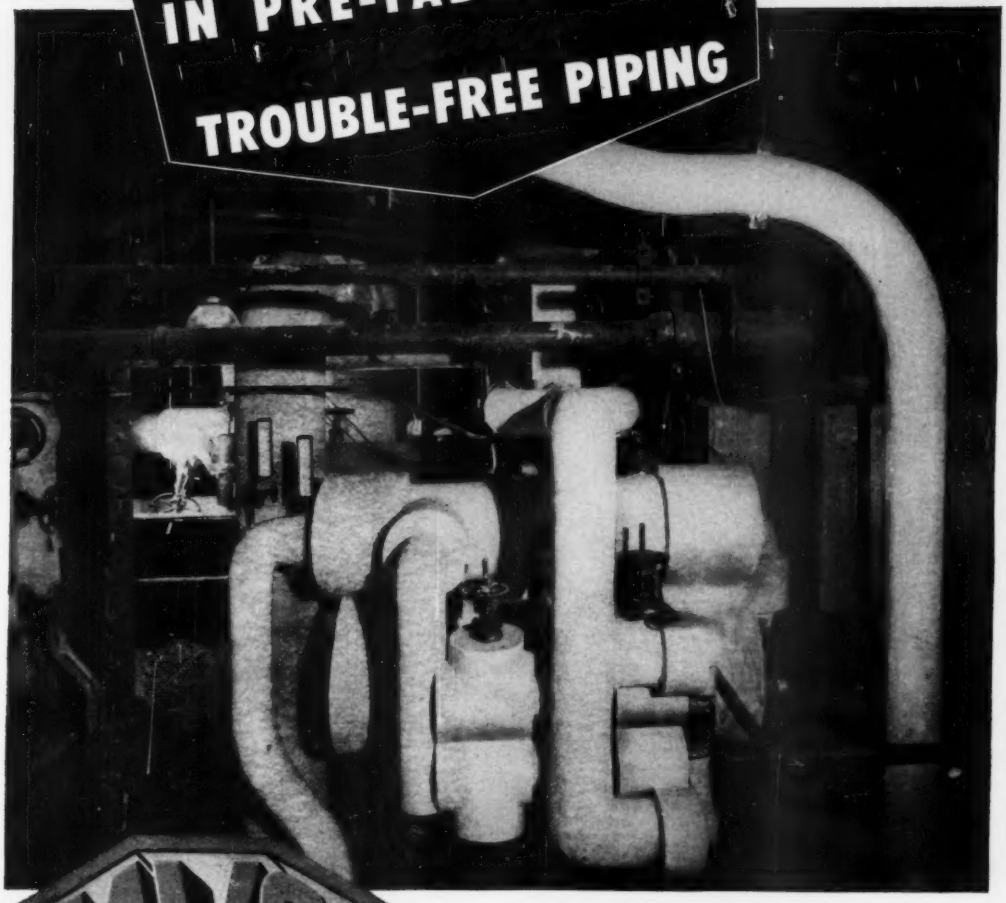

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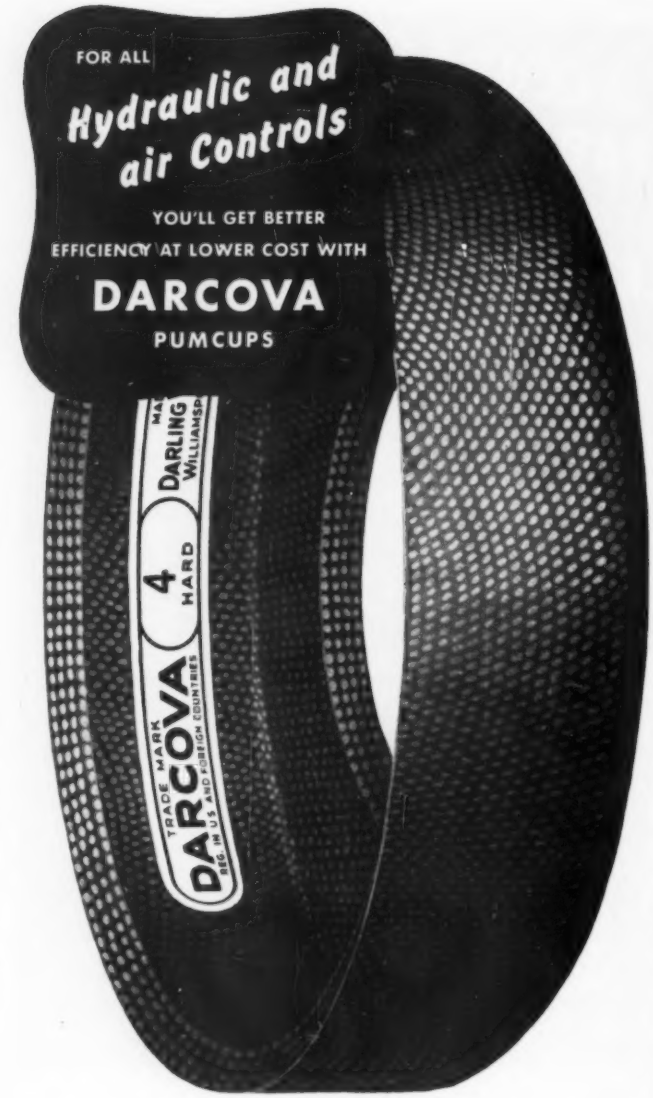

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PUMCUPS

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(Continued from page 46)

229 Steam Trap Reference Manual — Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure traps sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Also provided are installation and operating suggestions, prices. Yarnall-Waring Co.

230 Safety Head Catalog — Section 10, Part I of Catalog 54, 52 pp, is written in non-technical language and fully illustrated with cutaways and installation photos, charts and tables covering almost any phase of safety head information desirable. Tells where safety heads can be used and how to use them. Tells how to choose safety head assemblies and rupture discs. Includes tips for lowering temperature at point of safety head location. Black, Sivalls & Bryson, Inc.

231 Design Properties of Pipe — This 12-pp booklet consists of tables listing pipe sizes and wall thicknesses currently established as standard, plus what is believed to be a most complete tabulation of dimensional properties of commercially available sizes of steel pipe. Tube Turns, Inc.

232 Piping Pointers — This is company's highly popular 36-pp manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 fittings and contains illustrated how-to-do-it features. Includes 8 pp valve selection guide. Crane Co.

233 Unions and Fittings — Twelve-pp Catalog 50 covers manufacturer's line of unions of all types, elbows, tees and fittings. It describes and illustrates special features. E. M. Dart Mfg. Co.

234 Flanges for Severe Service — This 4-pp bulletin describes a flange specially developed for services involving severe abrasion and corrosives, and for suction and discharge service. Goodall Rubber Co.

ELECTRICAL

236 Power Factor Correction — Examples showing basic considerations in the improvement of system power factor are contained in Bulletin O5B7465. Points out advantages of improving plant power factor and advisability of keeping load power factor up to 0.8 lagging or higher; tells how the effects of low power factor can be corrected. Allis-Chalmers Mfg. Co.

237 Co-ordinated Protection of Motors — The interlinked protection of circuits, motors and personnel is explained in 12-pp Bulletin DB-4673 on high-voltage combination starters. Because almost every 2300/4800 v power system can produce high currents under short-circuit conditions, booklet stresses this interlinked protection, covering three classes of combination motor starters. Westinghouse Electric Corp.

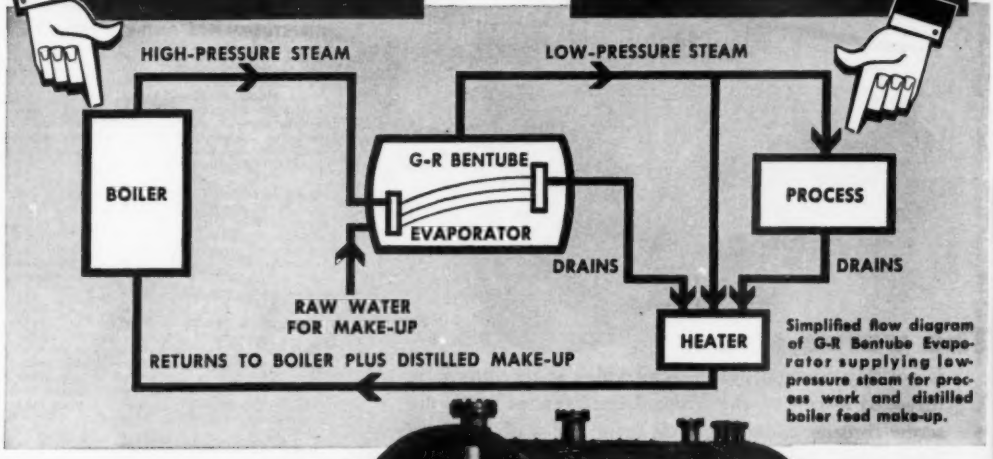
238 Care of A-C Rotating Equipment — To promote intelligent, consistent maintenance of electrical machines, company offers Bulletin O5R7417, a series of articles by Fraser Jeffrey. Contents of the 24-pp booklet cover preventive maintenance and machine repairs, drying moist insulation, measuring insulation resistance. Allis-Chalmers Mfg. Co.

PUMPS AND COMPRESSORS

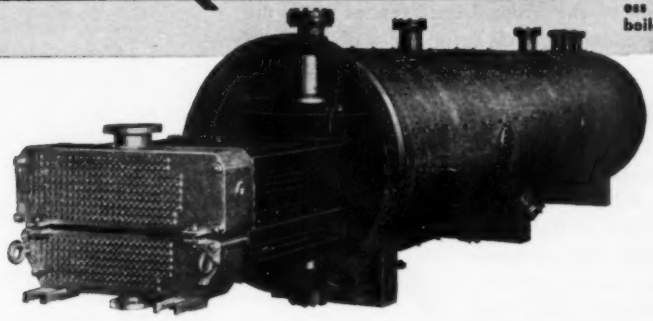
240 Compressor Selection Chart — Based on normal applications handling air with atmospheric intake pressure, this chart simplifies selection of proper size compressor, giving quick comparison between discharge pressure pounds per square inch gage and piston displacement cubic feet per minute. Shows recommended compressor bore and stroke in inches. Worthington Pump and Machinery Corp.

with a G-R Bentube Evaporator

PURE WATER for Boiler Feed Make-Up *plus* **STEAM for Process Work**



Simplified flow diagram of G-R Bentube Evaporator supplying low-pressure steam for process work and distilled boiler feed make-up.



This two-in-one unit can double as a 100% thermally efficient reducing valve and raw water purifier. Part of the vapor which it produces can be used as low-pressure steam for process work, while the remainder is condensed as distilled water for boiler feed make-up. The G-R "Reducing Valve" Evaporator wastes no heat . . . requires no chemicals.

For more than 50 years, G-R Evaporators have been proving their effectiveness and economy in marine and stationary installations, large and small. Today, they are in use in power generating stations, industrial and process plants all over the country, as well as on many hundreds of naval and merchant marine vessels . . . wherever pure water is a necessity.

The exclusive features and distinctive advantages of G-R Bentube Evaporators include their famous scale-shedding Bentube elements, design provisions for pure vapor, thorough drainage and easy accessibility. ●

Write for Bulletin describing these units in detail.

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The valve screw

is entirely covered by the long valve shaft, internally threaded to run on the screw. Liquid cannot touch the screw threads, cannot corrode them nor wash off their lubrication.

The valve disc

of gate valve type has an inserted rubber ring which operates like a windshield wiper on the valve seat as the valve is being closed. The disc can easily be taken out for replacement of the rubber ring after long use.

The wearing plate

supplied for particularly corrosive conditions, is simply a removable valve seat which can readily be replaced when required.

These are only some of the service-giving features of Twin Strainers. Get them all—write for the Twin Strainer Bulletin.

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241 Controlled Volume Pumping—Illustrated Bulletin 151, 24 pp, on controlled volume pumping will be of interest to engineers whose plant operations call for pumping a controlled volume of liquid in amounts from 3 ml per hour to 50 gpm. Describes features of company's pumps and includes data for selecting pumps for specific applications. 170 chemicals. Milton Roy Co.

242 Data on Pumps—All Types—Bulletins are available on centrifugal, reciprocating, screw and rotary pumps covering a wide range of capacities and services. Includes information on single and multistage, close coupled, single and duplex piston, and special pumps for handling erosive and corrosive liquids, also high viscosity liquids, both lubricating, non-lubricating. Warren Steam Pump Co., Inc.

INSTRUMENTS AND CONTROLS

244 For Centralized Control—Bulletin 109 presents compact Mini-Line equipment suited to control board arrangement which concentrates vital operating information and controls for one or more boilers, turbines or process units before a single operator. Describes and illustrates vertical-scale indicator units, selector valve, remote manual relay. Bailey Meter Co.

245 Putting the Ratio Totalizer to Work—Twelve applications of company's ratio totalizer in automatic control circuits are shown in 8-pp Bulletin 5450. This is a pneumatically operated control mechanism for combining input control pressures and spring forces to produce a single output control pressure. Hagan Corp.

246 For Practical Men—This 24-pp pocket-size booklet presents insulation testing in simple language. Packed with maintenance hints, explains electrical insulation, tells how it can be tested and what makes it go bad. It describes the Megger insulation tester and justifies its cost in long run economy. James G. Biddle Co.

247 Electronic Control System—Bulletin A-701 introduces company's Autronic system, a miniature all-electronic system for controlling pressure, temperature, flow and level, intended for use in chemical processing plants, refineries, central stations, other applications where fast, accurate control is required. The Swartwout Co.

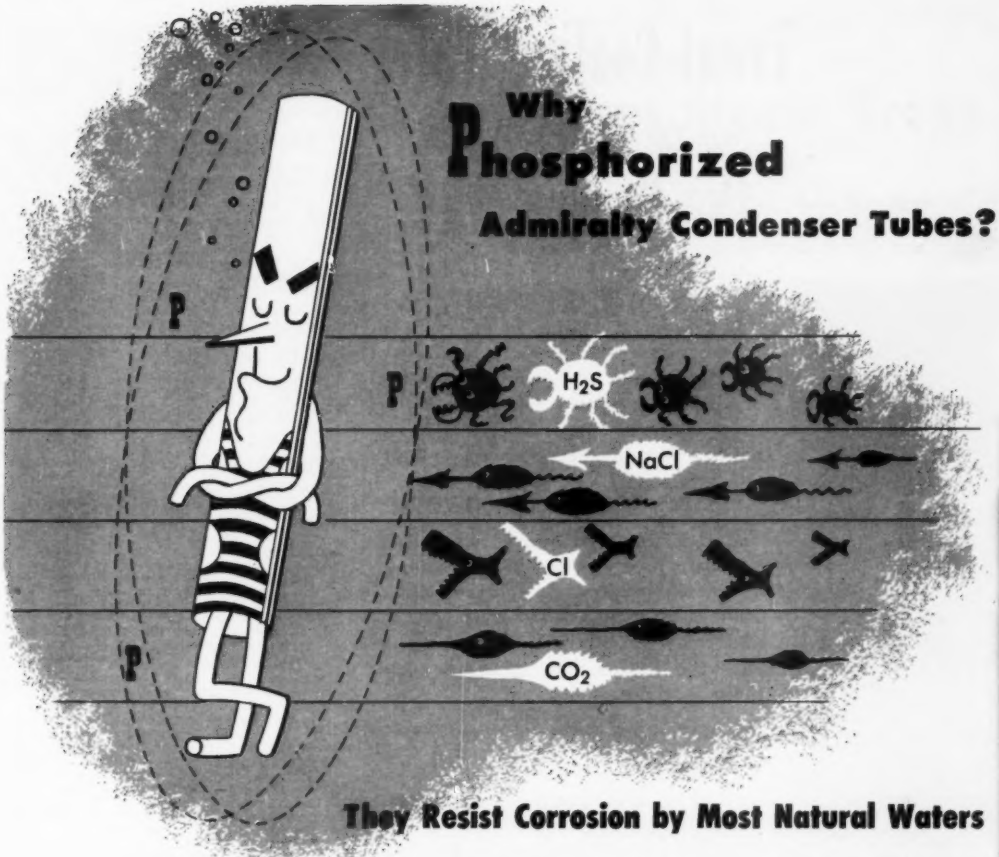
248 Instruments, Control Systems—Twelve-pp Catalog 513 presents manufacturer's line of instruments, control systems, regulating valves and desuperheaters. Covers draft and pressure instruments, boiler meters, recorders, thermometers, regulators, combustion controls, pump controls and many others. Republic Flow Meters Co.

249 Control from a Distance—Eight-pp Bulletin 230-H4 describes company's Chronoflo Telemeter for transmitting information and controls over a simple two-wire electrical circuit for unlimited distances. Explains operation of transmitter and receiver, illustrates mechanism and installations. Builders-Providence, Inc.

250 For Feedwater Analysis—Bulletin 148 BP contains a technical discussion of manufacturers analyzers for determination of dissolved oxygen and hydrogen in feedwater. Discusses both O_2 and H units as to function, ranges, accuracy. Cambridge Instrument Co., Inc.

251 Temperature Regulators—Twelve-pp Bulletin T, Catalog 80, describes manufacturer's line of regulators for controling temperature of liquids and gases, giving their applications, operating characteristics, construction specifications, dimensions. Eight instruments are presented. Fully illustrated, includes selection and application chart. Foster Engineering Co.

252 For Determining Steam Consumption—Bulletin R-513 explains design, construction, installation and



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They Resist Corrosion by Most Natural Waters

Whether you use fresh, salt or brackish circulating water, service records testify that Admiralty metal tubes have given very satisfactory performance in stationary power plant condensers.

Such corrodents as carbon dioxide, hydrogen sulfide, chlorine and metal salts, in the concentrations normally found in natural waters, or used in their treatment, are effectively resisted by tubes made of Admiralty.

Adding as little as 0.02% *Phosphorus* to Admiralty gives maximum resistance to dezincification while retaining all the other desirable properties of this alloy.

In order to assure uniform chemical composition and *soundness*, Scovill produces its Phosphorized Admiralty tubes by the continuous billet-casting process which continuously maintains the optimum amount of phosphorus. The tubes are hot-extruded from the continuous-cast billets, then are cold-drawn, annealed, cleaned and finished to produce tubes of uniform temper, gauge, straightness, roundness, diameters, length and freedom from burrs.

A Condenser Tube Booklet is available to qualified users who request it on their business letterhead. Scovill Manufacturing Company, 15 Mill Street, Waterbury 20, Connecticut.

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- Uniformity and soundness resulting from Scovill continuous-casting techniques
- Relative immunity to dezincification
- Excellent performance in fresh, salt or brackish waters
- High resistance to steam and condensate
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Treat Cooling Water *with Chlorine* — the Proven Way

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Hundreds of power plants and refineries have found chlorination by W&T the answer to heat exchanger slime problems. By eliminating slime forming microorganisms, maximum heat transfer is maintained in the condensers. The result — overall plant efficiency is kept at a maximum.

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High labor costs involved in frequent condenser tube cleaning are eliminated when chlorination is employed. Manhours used for tube cleaning can be utilized for other maintenance jobs, an important factor with the increasing manpower shortage.

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Years of operation have proved the dependability and accuracy of W&T Chlorinators for cooling water treatment. Low maintenance and automatic program operation keep operating costs to a minimum. For information on how you can solve your slime problems, contact your nearest W&T Representative or write to:

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operation of manufacturer's rotary condensate meter, an economical means of determining steam consumption where all condensate can be captured. Includes size, dimension and weight table, simplified piping diagrams for both gravity, vacuum systems. American District Steam Co., Inc.

253 Pressure Regulator — Bulletin 1-E, 8 pp, discusses design, operation and applications of a super-sensitive pressure regulator; shows typical installations. Also covers a compound regulator for controlling back pressure relief valve and high pressure make-up valve. Atlas Valve Co.

PACKINGS

255 Pump Packings — Packings for reciprocating and centrifugal pumps are described in this folder. Covers packings for practically all services. Johns-Manville.

256 Long Wearing Piston Packing — Form 4502, 8 pp, stresses use of company's composition cups for packing the pistons of air and hydraulic cylinders and reciprocating pumps. Engineering information covers properties, textures, temperature, pressure data. Darling Valve & Mfg. Co.

257 Teflon Packings — Form AD143 offers 8 pp of information on Teflon packings and gasketing material, giving properties, typical and special applications. Includes chapter on toxicology of Teflon at extremely high temperatures. The Garlock Packing Co.

258 Metallic Packing — An elastic metallic packing for compressors, engines and pumps is described as to construction and advantages in this illustrated bulletin. Explains easy installation of the packing, illustrates reciprocating rod and rotating shaft installations. A. W. Chesterton Co.

FANS, BLOWERS

260 Mechanical Draft Fans — Mechanical draft fans for both forced and induced draft service are described in 20-pp Bulletin 168. Illustrated with drawings of typical fan types and photos of installations, includes performance curves showing efficiencies of various types of fans. Gives construction features, drive arrangements. The Green Fuel Economizer Co., Inc.

261 Axial Flow Blowers — In this 6-pp illustrated bulletin are described axial flow blowers of both turbine-driven and motor-driven types. Gives capacity and dimensional data, operating range and specifications on both types. L. J. Wing Mfg. Co.

BOILERS AND AUXILIARIES

262 Re-Circulation Steam Generator — Here's a 6-pp folder on a controlled re-circulation steam generator, describing its development and uses, such as applications where steam is required in remote locations, where demands are intermittent, or load fluctuating. Explains operation, features. Combustion Engineering-Superheater, Inc.

263 Packaged Generators — Bulletin SB-38 presents company's Keystone model. Photos and sketches show complete unit, pressure element and details of its compact design. Gives advantages of two-drum water boiler, three-pass gas travel, automatic gas or oil burner. Erie City Iron Works.

264 Shop-Assembled Boiler — Eight-pp Bulletin G-72 introduces company's new integral furnace boiler. Describes and illustrates its economy, ease of installation and connection, flexibility, minimum space requirements, efficient combustion, fast steaming. The Babcock and Wilcox Co.

265 Tube Expanders — Bulletin 380, 8 pp, covers manufacturer's line of tube expanders for maintenance of high pressure boiler tubes, superheaters, economizers, circulating tubes, steam generators, other equipment. Thomas C. Wilson, Inc.

266 Rotary Tube Cleaners — Bulletin R-105 presents air and water driven rotary tube cleaners and cleaner accessories. Illustrates several models and heads, discussing special features. Roto Div., Elliott Co.

267 Streamlined Baffle Walls — Bulletin BW-44, 20 pp, describes company's baffle walls, showing their application to modern boilers and for modernizing existing units. Fully illustrated with photos and drawings covering installations, remodeling designs. The Engineer Co.

268 Air Preheaters — Illustrated Bulletin A-11610, 8 pp, defines air preheat and explains its benefits in terms of increased efficiency and capacity and flame stability. Provides general description of company's preheater, discusses its application to boiler plants. The Air Preheater Corp.

269 Soot Blower Head — Illustrated Bulletin 485 describes a rotary soot blower head for improved boiler cleaning. Explains how head is designed to give maximum blowing pressure, is rugged, easily serviced, economical. Vulcan Soot Blower Div., Continental Foundry & Machine Co.

270 Double-Walled Tubing — Technical Bulletin 1950, 12 pp, presents tubing designed for conditions where single-walled tube can't withstand simultaneous attack from two types of corrosive media. Describes and illustrates construction, illustrating possible metal combinations. Explains tubing's use in ammonia refrigeration, boilers, steam generators and other applications. Discusses heat transfer properties, high temperature use. Also discusses prevention of galvanic corrosion. Bridgeport Brass Co.

COAL AND ASH HANDLING

272 Spreader Stoker Selection — Fourteen-pp Form F-520-A10M is intended to help those choosing a spreader stoker to get the most for their investment, and it points out many factors to be considered. American Engineering Co.

273 Coal Scale — Bulletin 0250, 12 pp, describes a pressure-tight, automatic coal scale, its construction and operation. Shows how beam system, electrical components and linkages are protected from exposure to coal dust. Richardson Scale Co.

274 Ash Handling Systems — This 24-pp booklet offers technical information on hydraulic and pneumatic ash and fly-ash handling systems. Compiled in question and answer form. Discusses elements and advantages of various systems and disposal schemes. Schematic drawings of arrangements under specific conditions, diagrams of arrangements included. Beaumont Birch Co.

275 Coal Handling Equipment — Modern equipment for the storage and handling of coal and ash is presented in 24-pp Bulletin 300. Illustrated, covers concrete and tile silos, cylindrical steel tanks, suspended steel bunkers. Gifford-Wood Co.

276 Spreader Stoker Data — This is a file of three illustrated bulletins on spreader stokers. The first discusses seven reasons for selecting these stokers and describes their design, construction and operation; the second, dumping grates, the third, installations. Riley Stoker Corp.

277 Efficient Coal Preparation — Facts on improved coal preparation for power plants are presented in this 8-pp illustrated booklet. Shows how coal is split, not crushed, by rolling ring principle utilized in company's equipment to provide better combustion and reduced ashpit loss through uniform low-cost coal sizing. American Pulverizer Co.

278 Single-Retort Stokers — Catalog 350, 28 pp, is devoted to manufacturer's LoStoker, a complete mechanical firing unit for burning various grades of bituminous coal with high efficiency. Text and pictures cover operation, design and application of these single-retort stokers.

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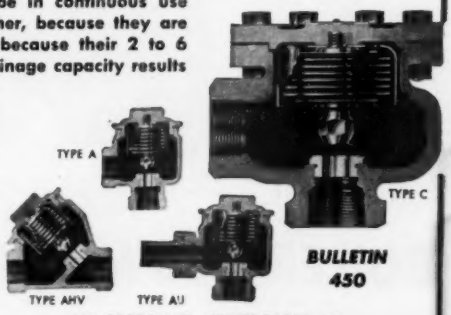
Freeze-Proof Steam Traps

for Every Plant Use

Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates heat transfer in severe weather. Size ¼" to 2"; pressures to 225 lbs.



BULLETIN 450

160 OREGON ST., WILKES-BARRE, PA.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS

CONTROL SCALE AND CORROSION

in BOILERS, STEAM and CONDENSATE LINES, WATER JACKETS, CONDENSERS — Wherever Water Is Used

Now, more than ever before, it is necessary to increase the efficiency and life of equipment by maintaining scale-and-corrosion-free water-side surfaces. Let experienced Wright Chemical Engineers check the requirements for water-conditioning chemicals to solve your problems.

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These EVERLASTING advantages give better service from

Fig. 4001/6561. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Angle Blowing Valve.

BOILER BLOW-OFF VALVES

When you install an EVERLASTING Duplex Blow-Off Unit, you'll find that its many superiorities speak for themselves.

The sealing valve at the left is the EVERLASTING design that has been famous for more than 40 years . . . the valve with the drop-tight seal that actually improves with use because of its self-lapping action each time the valve is opened or closed . . . the valve that can't stick or jam because of its non-wedge design . . . the valve that opens in less than a quarter turn to provide unimpeded straight-through blow.

The blowing valve at the right is the equally famous EVERLASTING Angle or "Y" Valve, specially designed and equipped to withstand repeated blow-off shocks, erosion and corrosion, and without pockets that might trap and hold solids.

Each of these valves . . . and all the other EVERLASTING Boiler Blow-Off Valve types, fully meet ASME code requirements . . . assurance that they are properly designed and amply strong for the service.

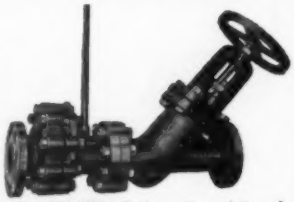

Fig. 4001/6571. Duplex unit consisting of Straightway Lever-operated Sealing Valve and Y Blowing Valve.

Fig. 4571/6561. Duplex unit consisting of Y Sealing Valve and Angle Blowing Valve.

Fig. 6561/6571. Duplex unit consisting of Angle Sealing Valve and Y Blowing Valve.

Write for descriptive bulletin

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COOLING

280 Heat Exchangers — Bulletin 11.0-080 describes air cooled heat exchangers for condensing or cooling of steam or process vapors, natural gas, jacket water, lubricating oil, quenching baths. Equipment Div., J. F. Pritchard & Co.

281 Cooler with Fins — A new oil and water cooler and advantages of its improved design are described in 20-pp Bulletin 1020. Explains how company's LK-Fin Cooler, distinguished by use of helically-finned heat transfer elements instead of bare tubes, is a lighter, more compact and less costly unit. Diagrams show comparisons of length and number of tubes and size of units for equivalent heat transfer surface. The Griscom-Russell Co.

282 Heat Exchangers — Bulletin 114, a small folder, gives concise information on company's Aero heat exchanger with balanced wet bulb control designed to cool engines or process equipment, coolants and lubricants, liquids and gases for processing operations. Niagara Blower Co.

283 Cooling Towers — Bulletin AQ-50 is on packaged water cooling towers in 3 to 50 t sizes. Gives specifications for the tower and discusses special features. Also provides dimensional and application data. The Marley Co., Inc.

284 Spray Nozzle Systems — Recooling spray nozzle systems for use in plants operating condensers or using large quantities of water for cooling, are covered in 8-pp Bulletin 6A-SP. It details design, application, construction, and operation of spray nozzles, and diagrams typical spray pond arrangements. Sizes, dimensions, capacities, and spray nozzle patterns are included in tabular form. Includes cooling performance curves for various temperature ranges. Schutte and Koerting Co.

COMMUNICATIONS

285 Civil Defense Communications — Form G93-122, 12 pp, pictures typical communications systems now in use which can be coordinated into a dependable emergency communications network in any community. Describes company's technical advisory service for civil defense radio communications and lists district representatives available to analyze existing systems and form them into a single emergency network. Electronics Dept., General Electric Co.

286 Power Plant Intercom System — A communication system custom tailored to individual plant conditions and designed for two-way conversation over microphones and receivers, as well as paging, is described in this 25-pp booklet. Text tells how system is easily installed and is adapted to different noise levels of a power plant. Photos show installations of paging equipment. Gai-Tronics, Inc.

CONDENSERS

287 Steam Condensers with Reserve Flow — Eight-pp Catalog 410-1 describes a "self-cleaning" reverse-flow condenser for power plant service, designed to virtually eliminate cleaning downtime and, in the case of divided water box condensers, eliminate operation at partial load. C. H. Wheeler Mfg. Co.

289 Ejector Instruction Manual — Bulletin J-50-7 is a 36-pp handbook covering operation, selection, installation and maintenance of steam jet air ejectors. Discusses twin and triple element ejectors, surface and jet inter- and after-condensers, isolating valves, drain traps, steam and back pressures, steam nozzles, condensing water, raw water cooling, recirculation and removal of condensate. Foster Wheeler Corp.

290 Steam Condensers — Bulletin 102, 24 pp, presents manufacturer's steam condensers and includes photos of typical in-

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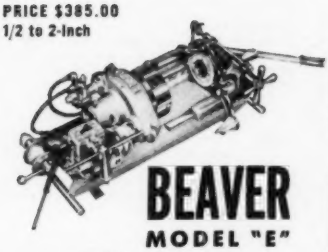

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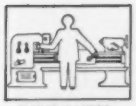

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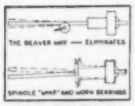

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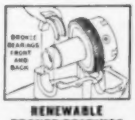

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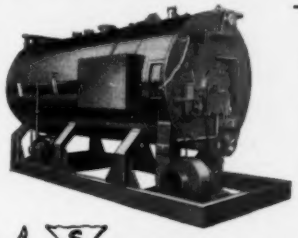

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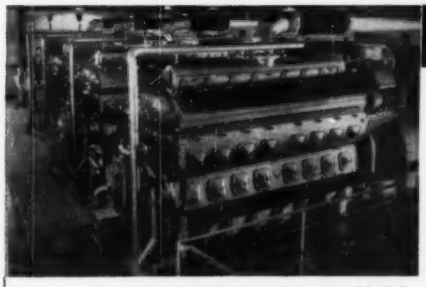

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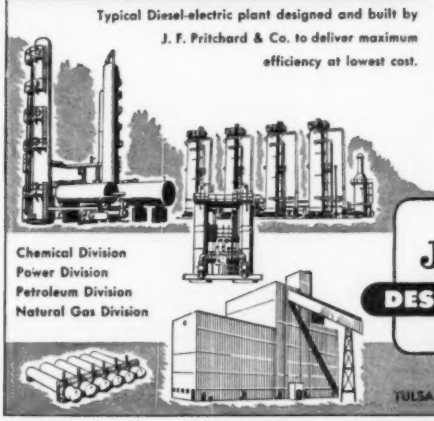

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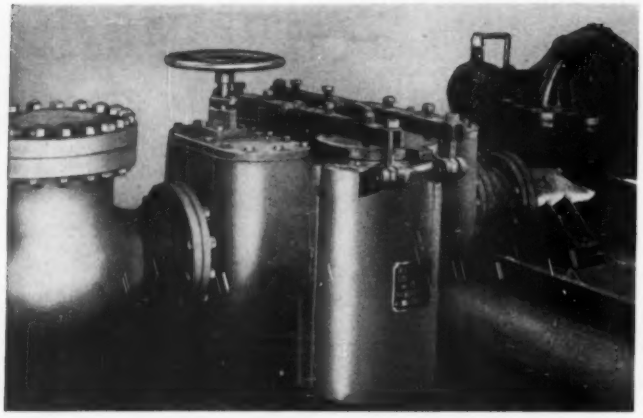

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stallations as well as engineering data, discussion of air removal equipment, and chapter on condenser maintenance. Company's Wizard injector to seal small leaks while condenser is in operation, air erosion eliminators, divers lights and port gages are also described. Condenser Service & Engineering Co., Inc.

TURBINES, GENERATORS

292 Multi-Stage Turbines — Six-pp Bulletin S-147 describes two of company's smaller-frame multi-stage turbines, both of the impulse type. Construction details are illustrated and described in detail. The Terry Steam Turbine Co.

293 Turbine Generators — Bulletin H-18, 40 pp, covers turbine-generators of 500 kw and above, pictures nearly 50 turbine-generator installations, both utility and industrial. Brief discussions of generator and exciter cooling methods are included. A reference section offers detailed drawings showing a typical turbine condenser installation arrangement. Elliott Co.

REFRACTORIES, INSULATION

294 Refractory Brick — Electric furnace fused refractory bricks and their use is described in Form 862, 16 pp. Gives installation procedure on a high quality silicon carbide brick for boiler furnaces and gas generators. Also describes a fused aluminum brick of high refractoriness. Fully illustrated. Brick shapes are pictured, sizes listed. Norton Co.

295 Incombustible Material — "The Story of Kaylo," 24 pp, describes company's new basic material, an hydrous calcium silicate product, covering some of the many uses for this incombustible material in construction and industrial fields. Tells how product was developed, describes its properties, tells densities available for thermal, insulating and structural applications; illustrates available forms. Kaylo Div., Owen5-Illinois Glass Co.

296 Industrial Insulations — Selection and application information on insulating materials is presented in this 28-pp illustrated catalog. Covers block and blanket insulations, insulating cement, low pressure coverings, felt, other products. Gives specifications, temperature ranges, recommended thicknesses, prices. Baldwin-Hill Co.

OTHER EQUIPMENT

297 The ABC of CO_2 — An interesting text covering role of carbon dioxide in combustion efficiency, 16-pp illustrated Bulletin 452 discusses theoretical vs practical perfection of combustion and tells how to determine percentage of CO_2 in flue gases. CO_2 as a basis for figuring heat and fuel losses is also described and method of determining such losses explained. Includes scales of total heat losses of various types of coal, fuel oils and gas. The Hays Corp.

298 Water Heaters — Illustrated 6-pp Bulletin 70, Section I, on instantaneous type water heaters contains detailed capacity and dimension tables for two-, four- and six-pass designs, with tube bundles removable. Davis Engineering Corp.

299 Fundamentals of Hydraulics — Technical Bulletin B-4, 44-pp covers hydraulic systems, maintenance trouble-shooting and selection of proper fluids. Besides offering reference data to engineering personnel, this book is suggested as a training manual for maintenance supervisors, operators. It features phantom and cutaway drawings illustrating functions of basic types of valves, pumps, hydraulic motors, torque converters. Sun Oil Co.

300 Steam Atomizing Oil Burners — Sixteen-pp illustrated Bulletin 21 describes steam atomizing oil burners and auxiliary equipment for use with heavy oil or tar in boilers, stills, dryers and other furnaces, where steam or compressed air is available for atomizing the oil. Discusses steam and oil control valves. National Airoil Burner Co., Inc.

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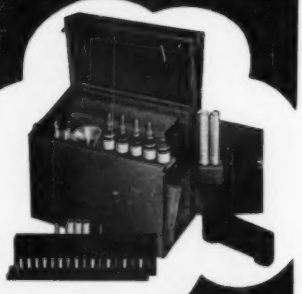

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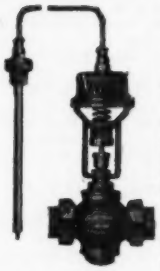

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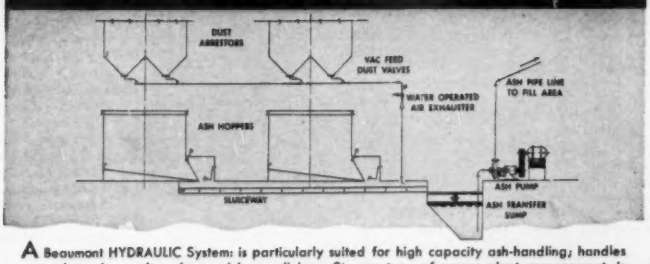

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Babbitt
Adjustable
SPROCKET RIM
with Chain Guide

A range of 10 ADJUSTABLE sizes fits all valve wheels, with rising or non-rising stems, from 2 to 30 inches in diameter.

ADJUSTABLE . . . fits all valve wheels

CUTS COSTS . . . simplifies pipe layouts

CUTS ACCIDENTS . . eliminates climbing

PREVENTS ACCIDENTS! No more climbing to operate overhead valves.

PREVENTS WASTE! Positive control, immediate response.

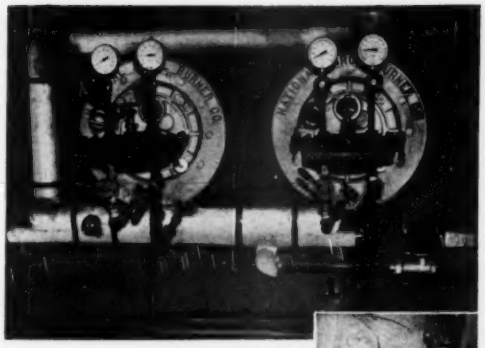
EASY CONTROL! Easier than direct manual operation.

SAVES MONEY! Avoids accidents, permits piping short-cuts, saves piping costs.

• Here's easy, convenient, instant control of overhead, out-of-reach valves — right from the floor! Four simple, quickly-assembled parts and the valve handwheel is ready to operate.

Distributors in principal cities, or send for Catalog Folder PE-2 and name of nearest distributor.

BABBITT STEAM SPECIALTY CO.
1 Babbitt Square, New Bedford, Massachusetts



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(1) Refractory Faced Disk Control
(2) Air Vane Control

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You get better performance with NATIONAL AIROIL Universal Registers because they have a dual feature for controlling air volume independent of turbulence. Air vanes can be instantly reversed to change direction of turbulence while air volume is separately regulated by a refractory faced disk. Both adjustments can be made while the burner is firing.

NATIONAL AIROIL Universal Registers are equipped for dual fuel firing of gas and oil.

Universal Registers with burners are manufactured in three sizes with capacities up to 60,000 pounds of steam produced per burner per hour.

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OIL BURNERS and **GAS BURNERS** for industrial power, process and heating purposes; **STEAM ATOMIZING OIL BURNERS; MOTOR-DRIVEN ROTARY OIL BURNERS; MECHANICAL PRESSURE ATOMIZING OIL BURNERS; LOW AIR PRESSURE OIL BURNERS; GAS BURNERS; COMBINATION GAS and OIL BURNERS; AUTOMATIC OIL BURNERS** for small process furnaces and heating plants; **FUEL OIL HEATERS; FUEL OIL PUMPING** and **HEATING UNITS; FURNACE RELIEF DOORS; AIR INTAKE DOORS; OBSERVATION PORTS; SPECIAL REFRACTORY SHAPES.**

NATIONAL AIROIL BURNER CO., INC.

Main office & Factory: 1268 EAST SEDGLEY AVENUE
PHILADELPHIA 34, PA.
SOUTHWESTERN DIVISION: 2512 SOUTH BLVD.
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Remove Oil...

FROM BOILER AND PROCESS WATERS THIS NEW LOW-COST WAY!

What it is —

Filtration with Sorbo-Cel is a simple, low-cost method of removing emulsified oil from water. In plants using steam generating equipment, it is proving an especially effective and economical means of obtaining oil-free condensate for boiler feed. It also provides a practical solution to other oil-contaminated water problems, such as the water used in pumps, condensers, cooling systems, moving driers, etc.

How it works —

The method is similar to that used in other conventional industrial filtration operations. A small amount of Sorbo-Cel (a specially processed diatomaceous silica powder), is added to the water to be filtered. This is then pumped through a pressure filter where the oil globules are adsorbed by the specially treated Sorbo-Cel particles. Both are retained on the filter screen, the filtered water alone passing through. Any type of pressure filter having a metal screen and capable of operation at a pressure differential of 30 psi or more may be used.

What its advantages are —

Sorbo-Cel filtration is fast, economical and efficient. It assures virtually complete removal of oil, as well as suspended solids such as rust, scale, clay, etc. Large volumes of water are filtered in a relatively short time, yet total costs (including both material and operation) range from only 1¢ to 3¢ per 1000 gallons of water filtered.

For further information about Sorbo-Cel filtration use the coupon below.

JM PRODUCT

Johns-Manville SORBO-CEL

Johns-Manville
Box 290, New York 16, N. Y.

Send me free bulletin giving advantages of Sorbo-Cel filtration.

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Company_____

Address_____

City_____ State_____

PG-4

CLASSIFIED ADVERTISING

HELP WANTED

ELECTRICAL ENGINEER

. . . with extensive experience in the industrial application of electric power; control and distribution systems; and design, construction, installation, operation, and testing of equipment to supervise activities of section engaged in research on electrical equipment and materials. This is not a temporary or "emergency" job, but a career opportunity on the regular staff of the Engineering and Construction Department of a major petroleum company. We are looking for a man who is approaching the $10,000 bracket and is ready for greater responsibility. Reply, in confidence, to Mr. H. M. Overley, The Atlantic Refining Co., P. O. Box 7258, Phila., 1, Pa.

WANTED
Mechanical Engineer

Experienced in Power operations for modern, expanding chemical manufacturer in Ohio Valley, West Virginia panhandle. Two to three years experience preferred. Box 1664, Power Engineering, 110 S. Dearborn St., Chicago 3, Ill.

EQUIPMENT FOR SALE

5000 K.V.A., 2300/4000 volt, 450 pressure General Electric Turbo-generator with all auxiliaries.

B & W. Integral Furnace boiler designed for 50,000 lb per hour at 420 psi operating pressure.

Details on request. Box 1662, Power Engineering, 110 S. Dearborn St., Chicago 3, Ill.

1 — 75 H.P. CHUSE STEAM ENGINE 10 x 10, 300 rpm, connected to Western Electric 120 amp alternator, 40 kw, 240 volts, 3 ph., 60 cycle, also exciter and switchboard panel for generator, including voltage regulator, main switch, volt and ammeters. $2000.00. Also 1 — 4" x 8" Gould's Triplex Boiler Feed Water Pump. $350.00. Saxony Mills, St. Louis, Mo.

One (1) Chuse non-releasing Corliss engine direct connected to 312 kva, 240 volt Generator, with belt driven exciter. Can be inspected in operation. Director of Purchases, KIRSCH COMPANY, Sturgis, Michigan.

1 — 400 kw Westinghouse A.C. to D.C. Synchronous Rotary Converter purchased new 1941. Complete with step-down transformer, 13,200 volt, 60 cycle, 3 phase Primary, 188 volt, 6 phase Secondary, Circuit breaker, disconnect switch, starting panel and 125-250 volt, D.C. panel complete with circuit breaker, main switches, volt and ammeter. Wm. Martien & Co., Inc. Agents, Candler Bldg., Baltimore 2, Md.

ATTENTION ENGINEERS — EXTRA INCOME. You get the commission when you use our sludge-solvent in your fuel tanks or our soot-remover in your firebox. For particulars write Amionic Chemical Co., P. O. Box 371, Taunton, Mass.

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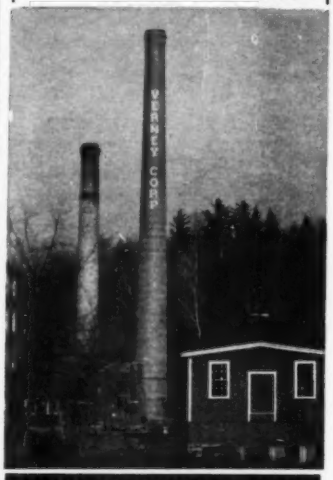

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Steel Valves Score on all 3 Points

1

CHAPMAN STEEL VALVES have the high precision ratings of custom-made valves — but the economy of production-line manufacture.

2

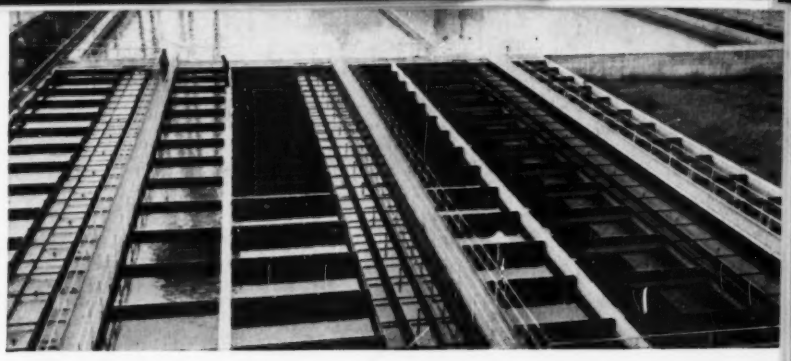
CHAPMAN STEEL VALVES are made exclusively from quality-controlled steels developed and produced in Chapman's own foundries under control of Chapman's own outstanding metallurgists.

3

CHAPMAN STEEL VALVES are designed to equal or surpass — A.S.A. and A.P.I. Standards in all pressures and temperature ranges.

Be sure to see Chapman first whenever you need steel valves — gate, globe, angle or check. As a result of Chapman's long years of research and experience, they are tops in every respect.

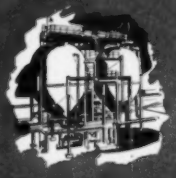
The Chapman Valve
MANUFACTURING COMPANY
INDIAN ORCHARD, MASS.



Three Permutit Precipitators at Alcoa's Davenport, Iowa plant. Each processes 3,000,000 gallons of water a day.

How Permutit helps Alcoa get BETTER WATER...

THESE BASIC PROCESSES, PLUS PERMUTIT SKILL, CAN SOLVE YOUR WATER CONDITIONING PROBLEMS

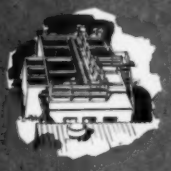


1. SLUDGE BLANKET HOT LIME SODA. Application of the sludge blanket to hot lime soda treatment reduces silica in boiler feed make-up, produces high quality steam.

2. HOT ZEOLITE—PERMUTIT Q. Subsequent treatment of water from hot lime soda treatment yields effluent of zero hardness. Permutit Q, or styrene base mineral resistant to high temperatures, replaces second stage phosphate treatment.

3. SILICA REMOVAL PLUS DEMINERALIZATION. Demineralization by cold ion exchange processes produces water comparable to distilled water only at a fraction of the cost of distillation. Treatment by anion exchange resin, Permutit S, reduces silica to less than 0.2 ppm.

4. DEAERATING HEATER. The Permutit Deaerating Heater, utilizing exhaust or bled steam, prevents corrosion of feed lines, stage heaters, economizers, and boilers, by removing oxygen and free CO_2. Capacities from 12,000 to 1,400,000 pounds per hour are in service.



5. PRECIPITATOR. The Permutit Precipitator is used to lower alkalinity, reduce hardness, and help to remove turbidity, color, taste and odor. It can also be used to reduce silica.

with
LOW TURBIDITY
LOW OPERATING COST
LOW CHEMICAL COST
LOW WATER WASTE

Alcoa's water needs average 9,000,000 gallons per day in their Davenport, Iowa plant. A Permutit Precipitator processes all their mill use water, and yields an effluent turbidity of only 5 ppm from an influent turbidity as high as 900 ppm. Yet operating cost, including pumping, chemicals, depreciation and maintenance, is only 5¢ per thousand gallons. Of this, chemical cost is less than 2¢ per thousand. Water waste has averaged only 8.75%.

Precipitators for lowering alkalinity and removing turbidity of water are only one of many Permutit products for solving water conditioning problems. In the column at left, some of the more important basic processes are illustrated and described.

Find out how Permutit can solve *your* water processing problems. Write to The Permutit Company, Dept. PE-1, 330 West 42nd Street, New York 36, N. Y., or to Permutit Company of Canada, Ltd., 6975 Jeanne Mance St., Montreal.

PERMUTIT®

WATER CONDITIONING HEADQUARTERS FOR OVER 38 YEARS